

FIG.1

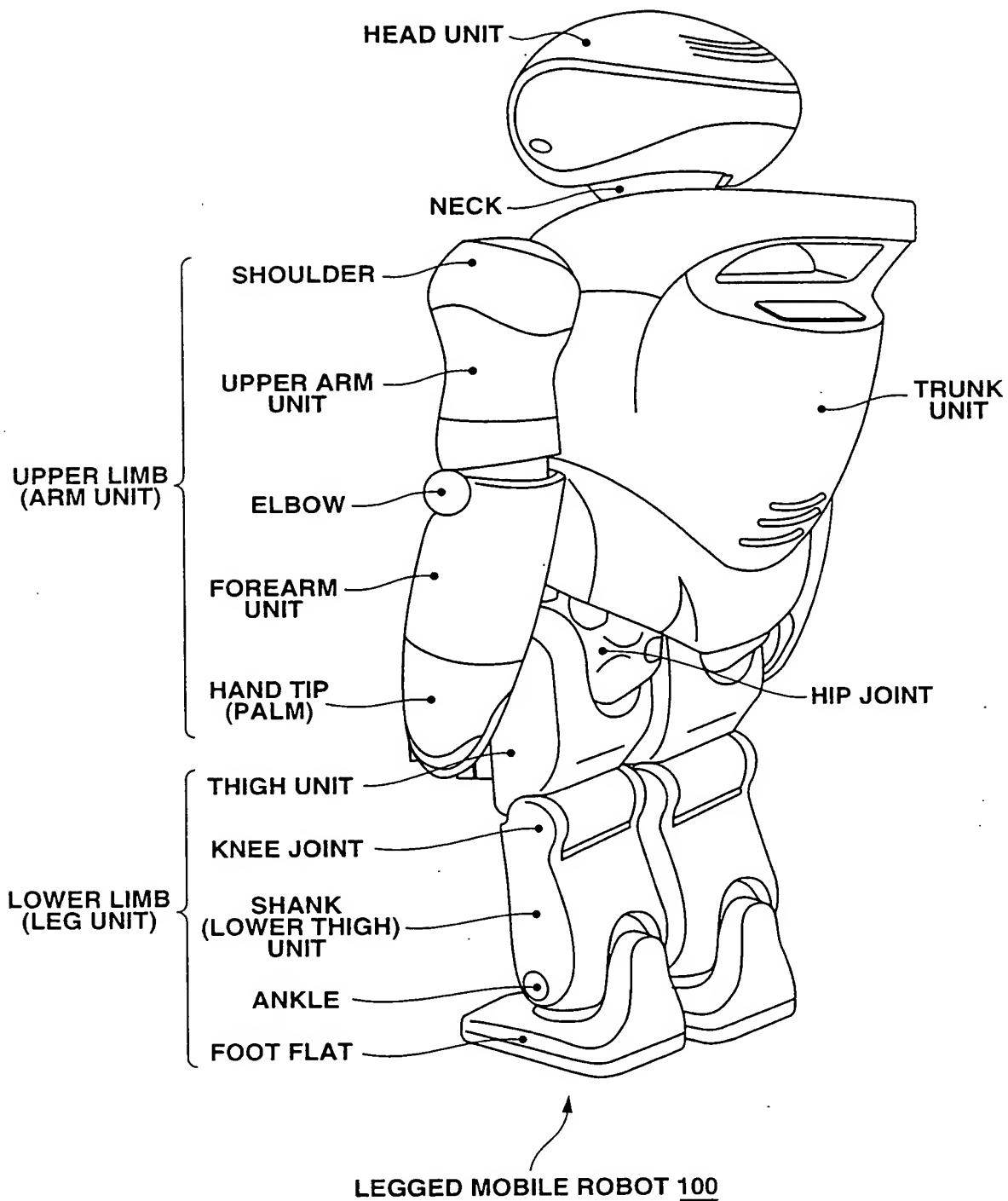


FIG.2

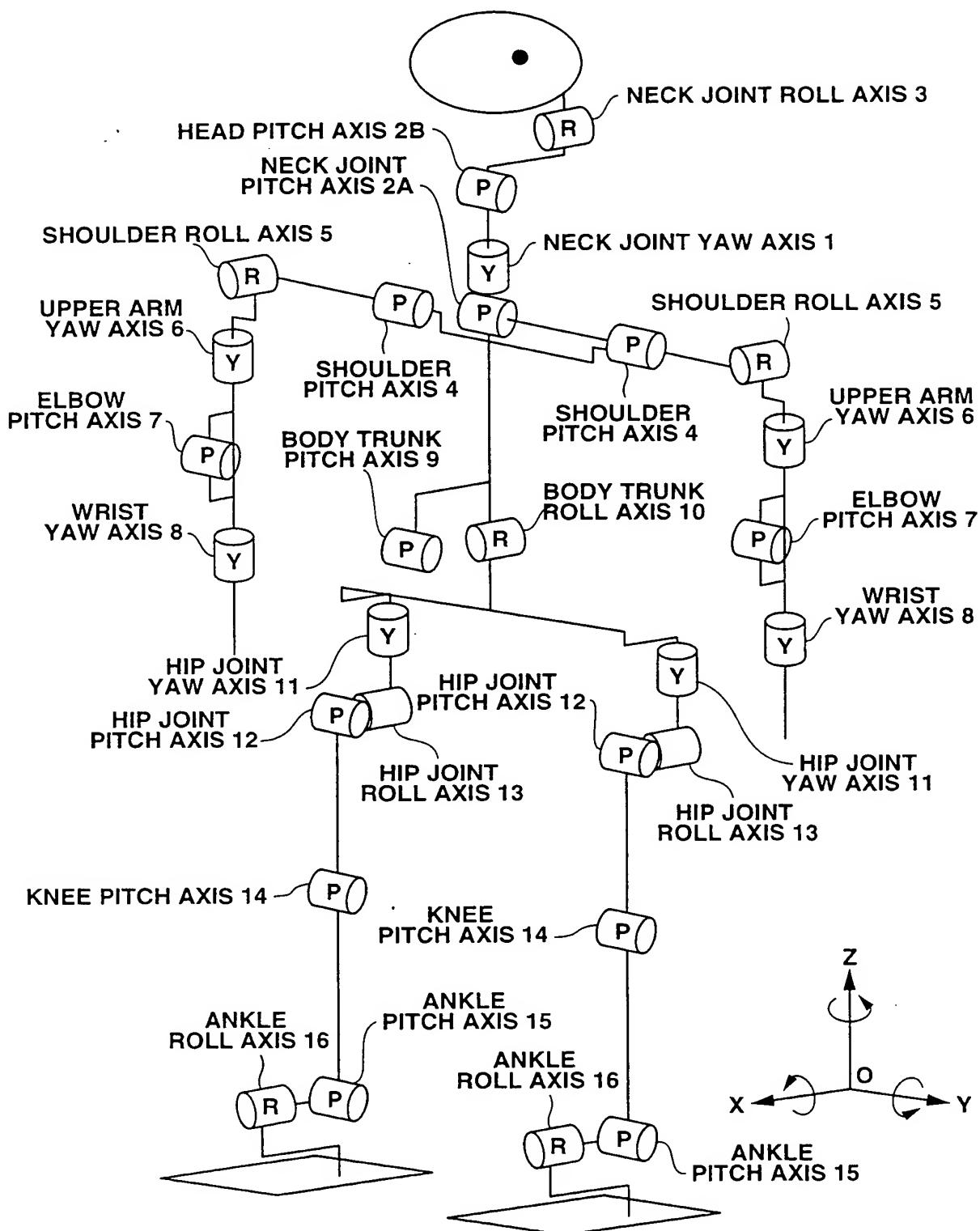


FIG.3

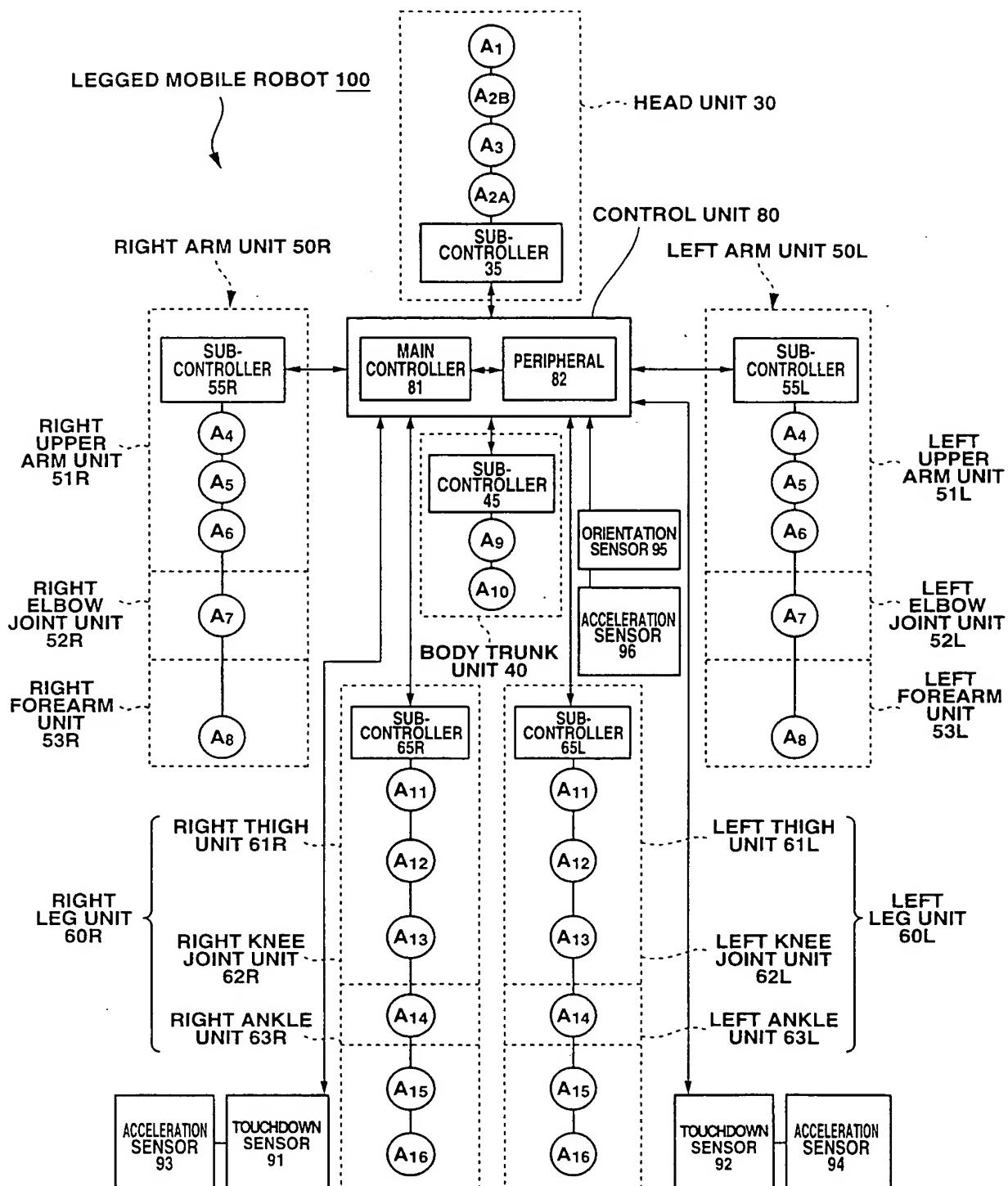
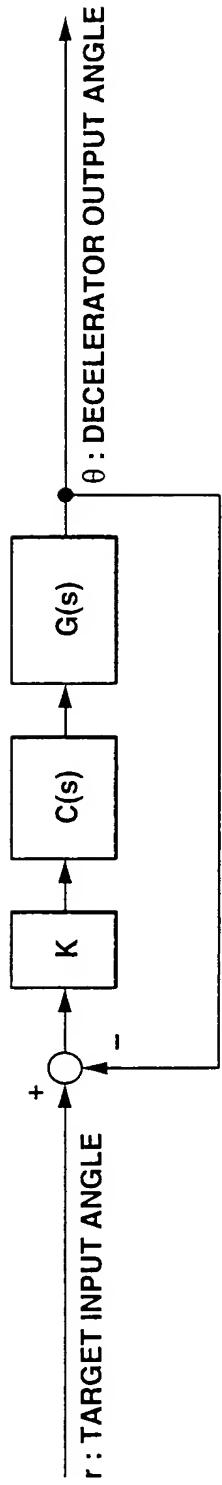


FIG.4



K : SERIAL COMPENSATION GAIN (PROPORTIONAL GAIN)

$C(s)$: TRANSFER FUNCTION OF PHASE COMPENSATION ELEMENT

$G(s)$: MODEL FOR REPRESENTING TRANSFER FUNCTION FOR
MOTOR AND DECELERATOR

FIG.5

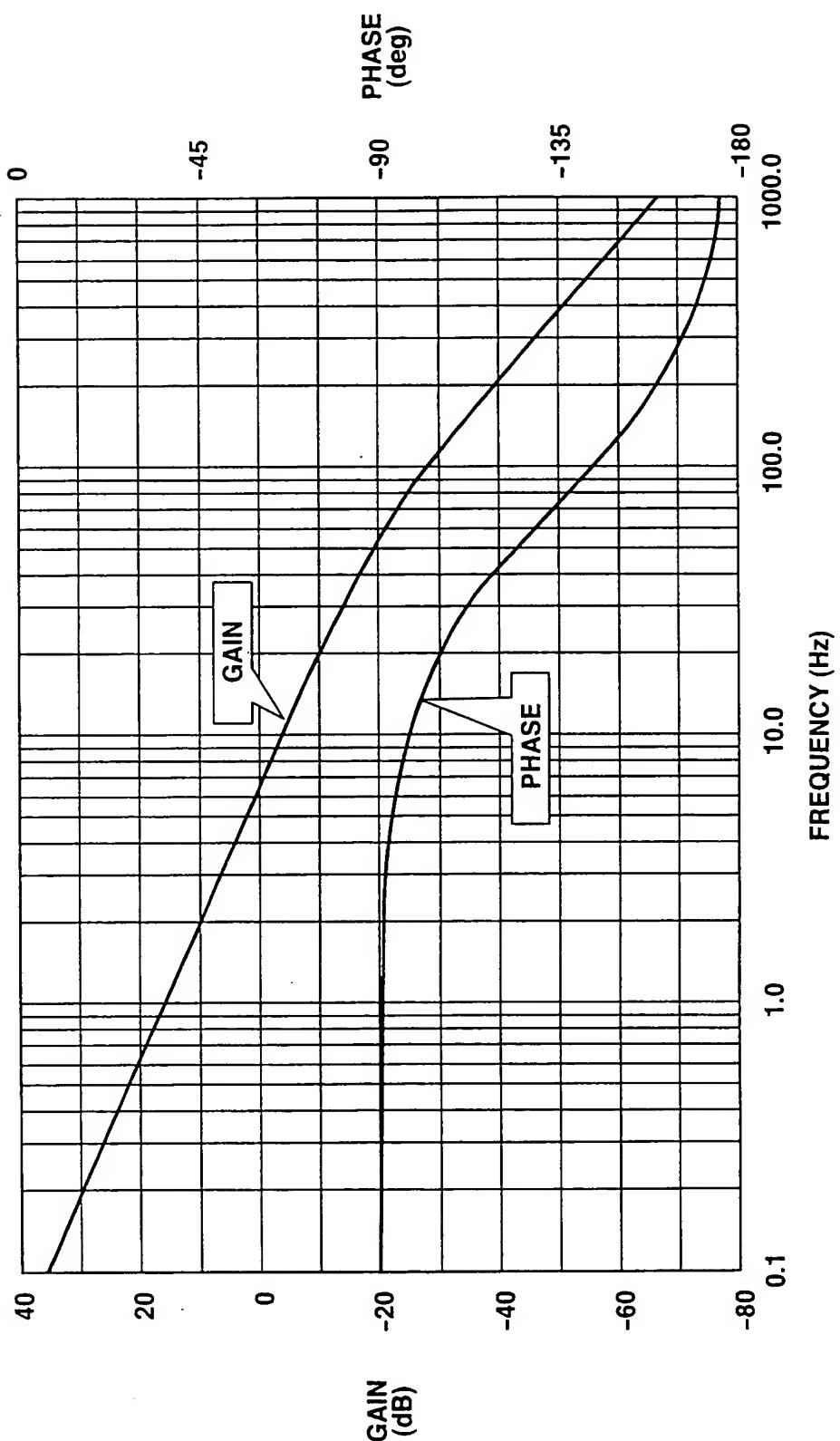


FIG.6

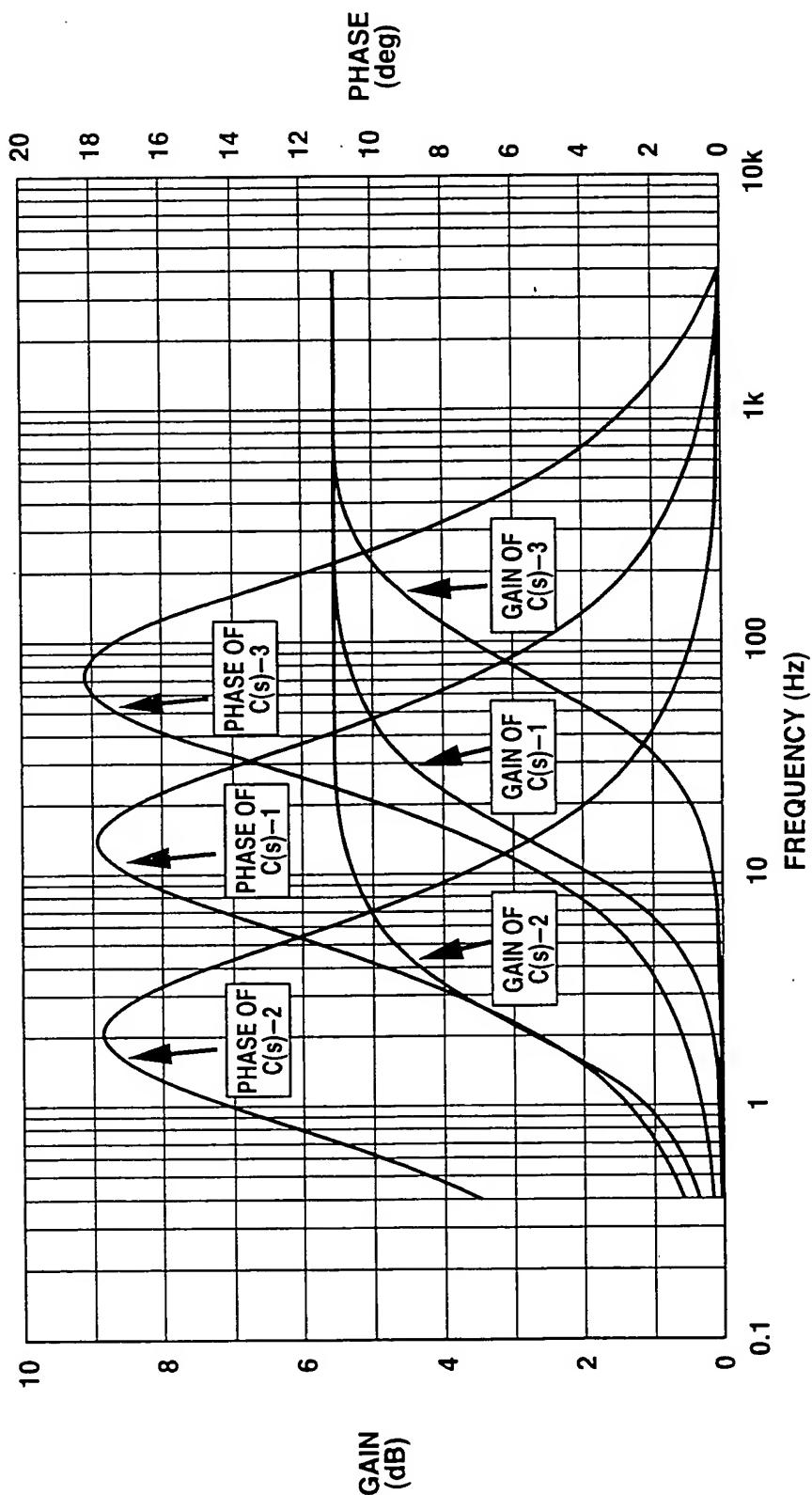


FIG.7

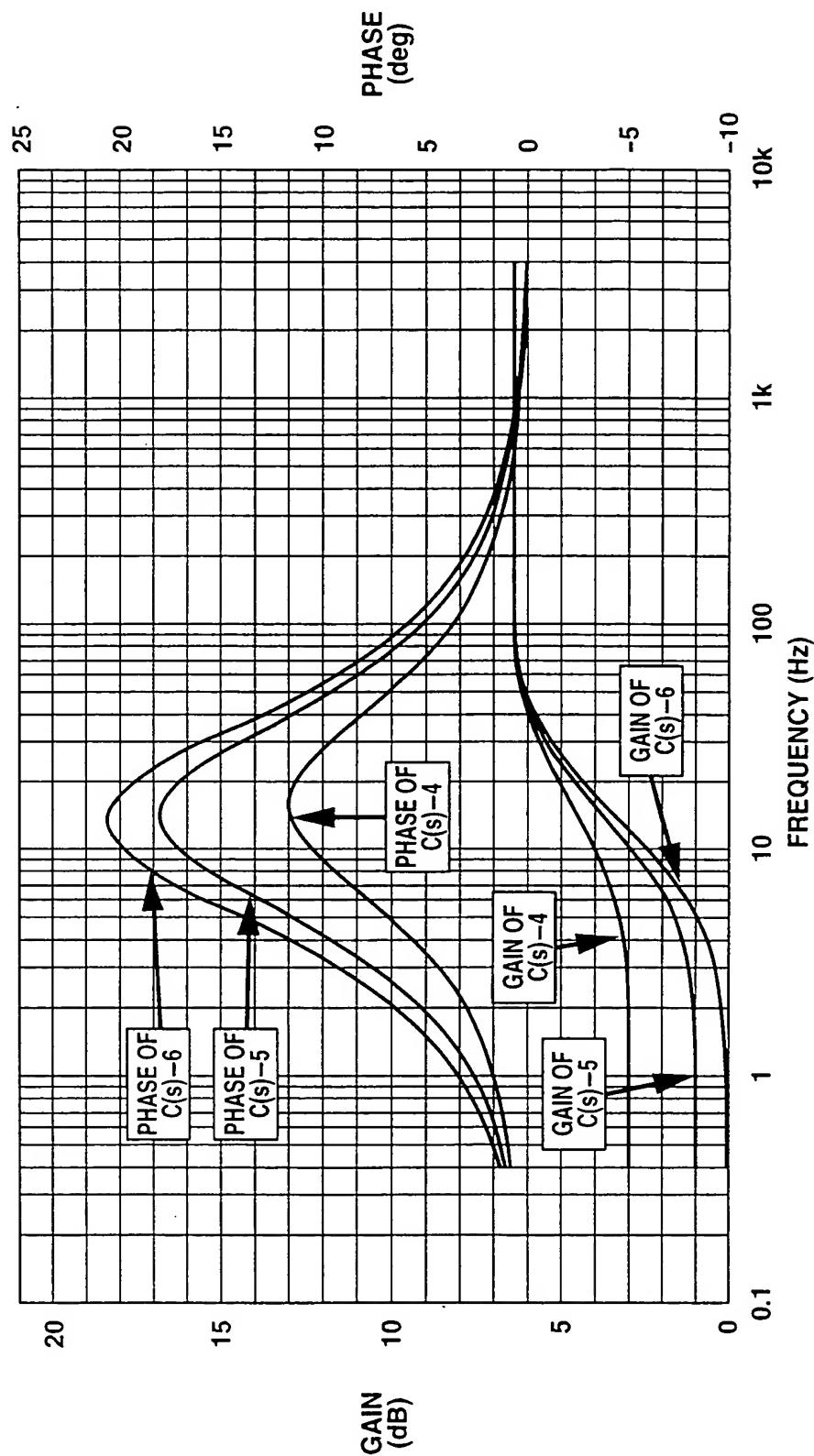


FIG.8

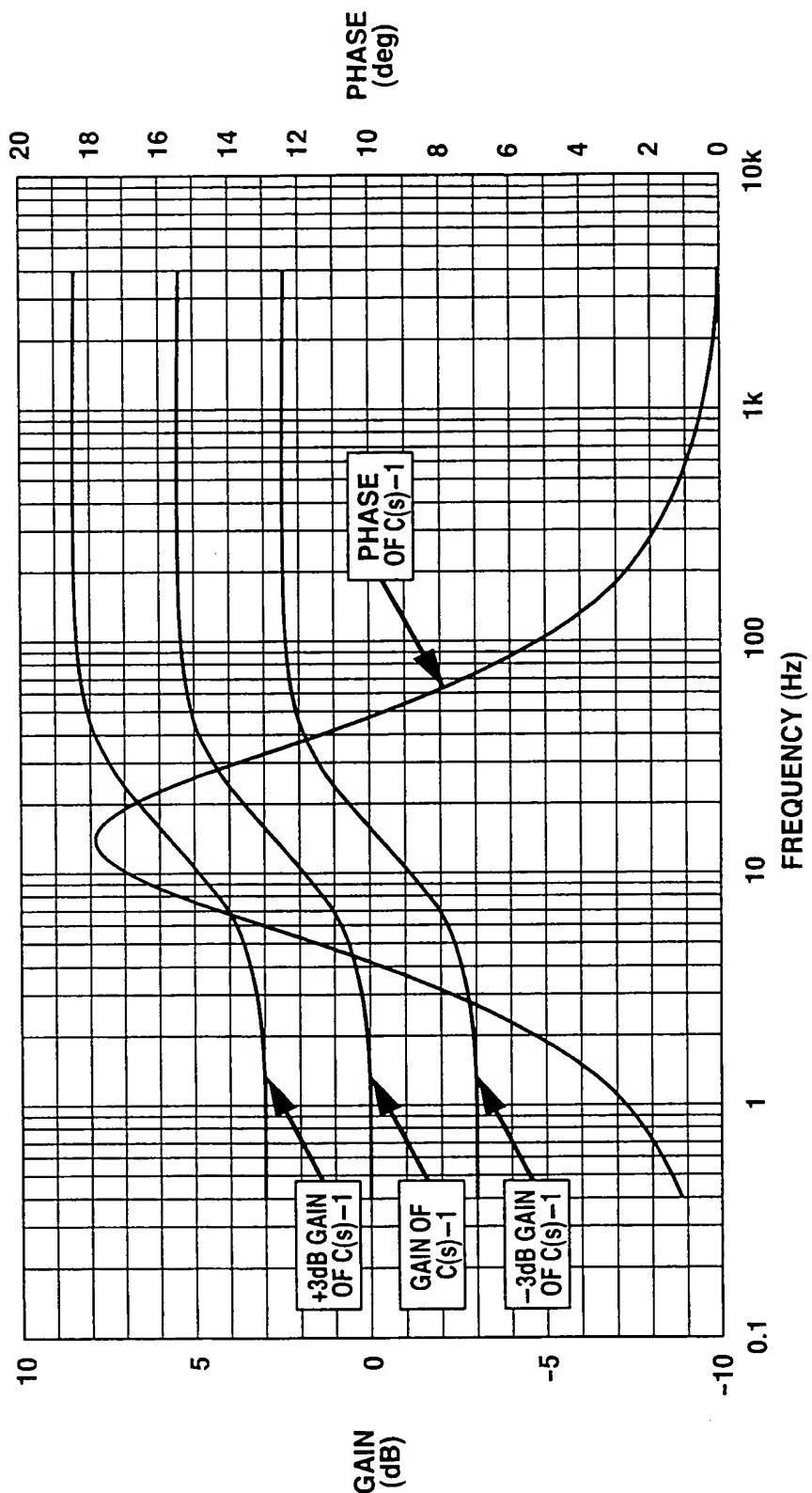


FIG.9

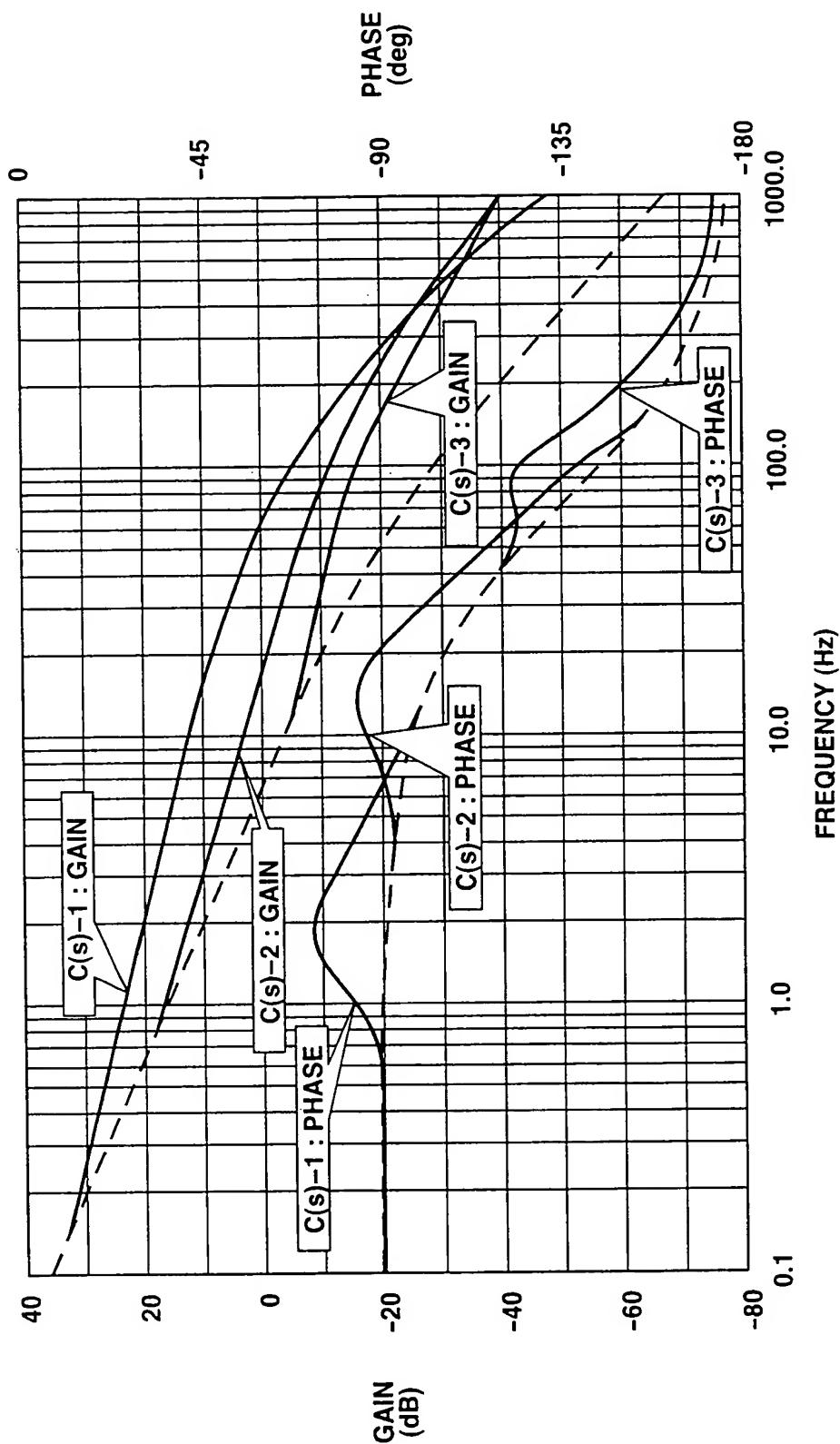


FIG. 10

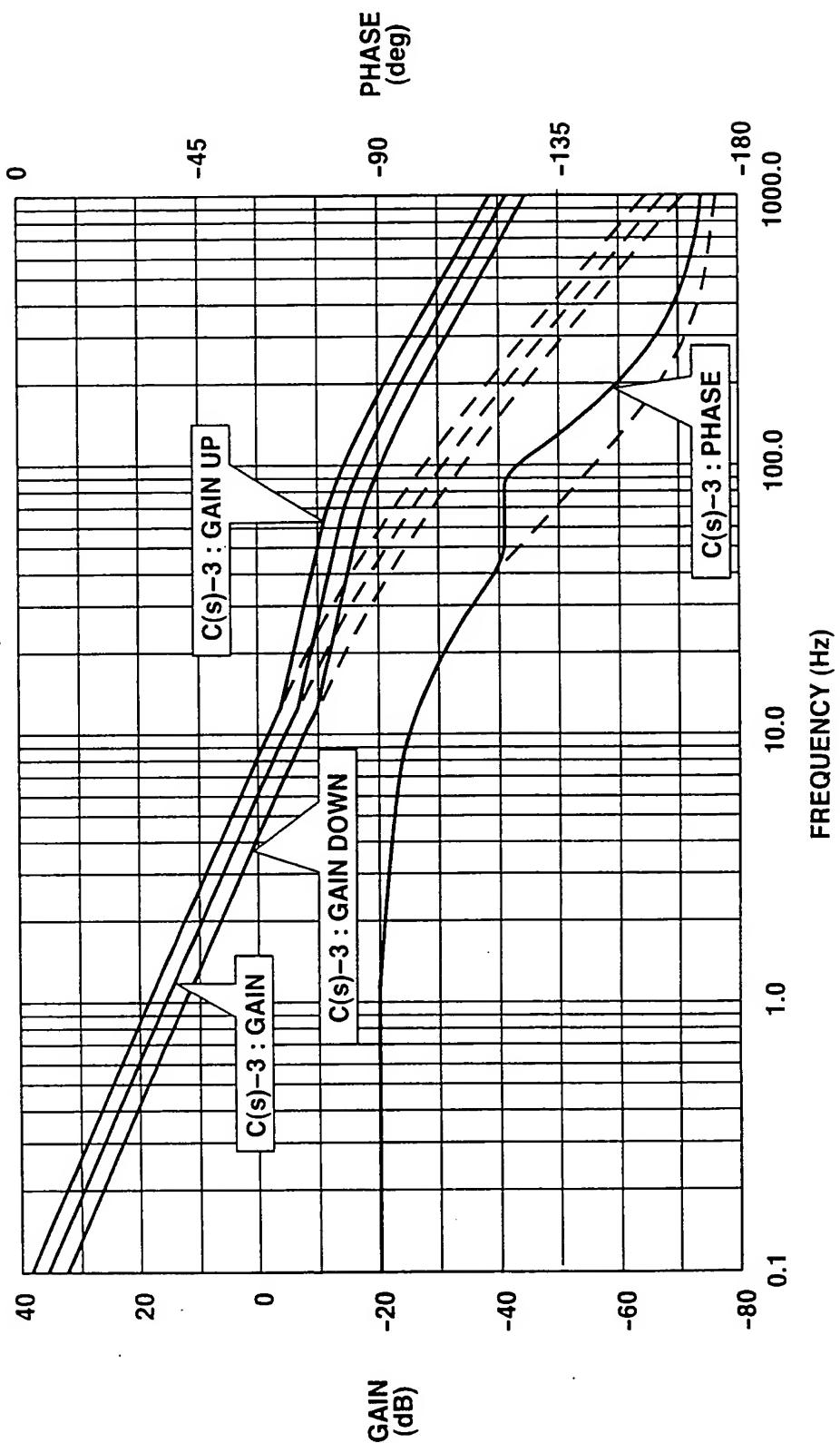


FIG. 11

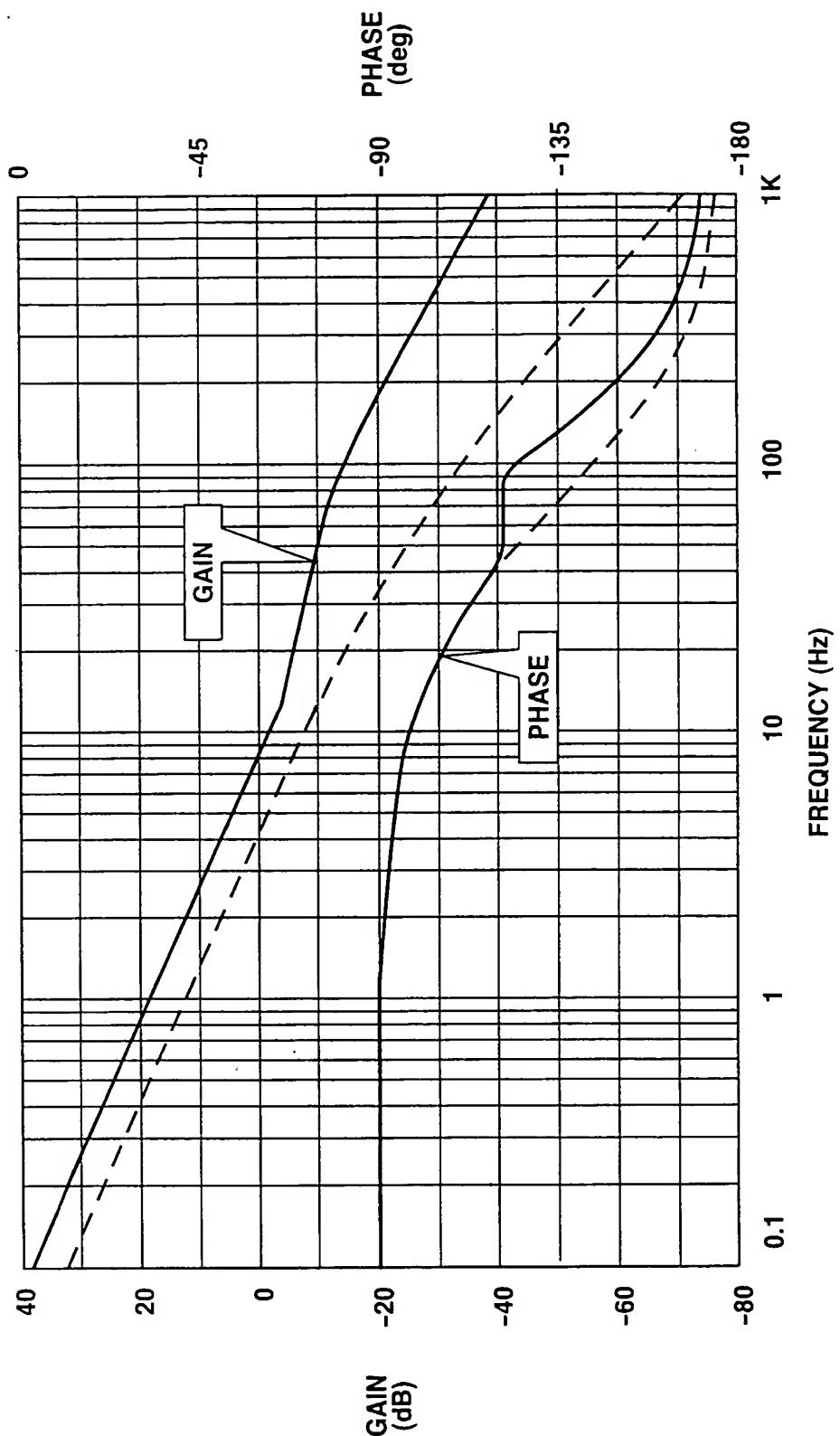


FIG.12

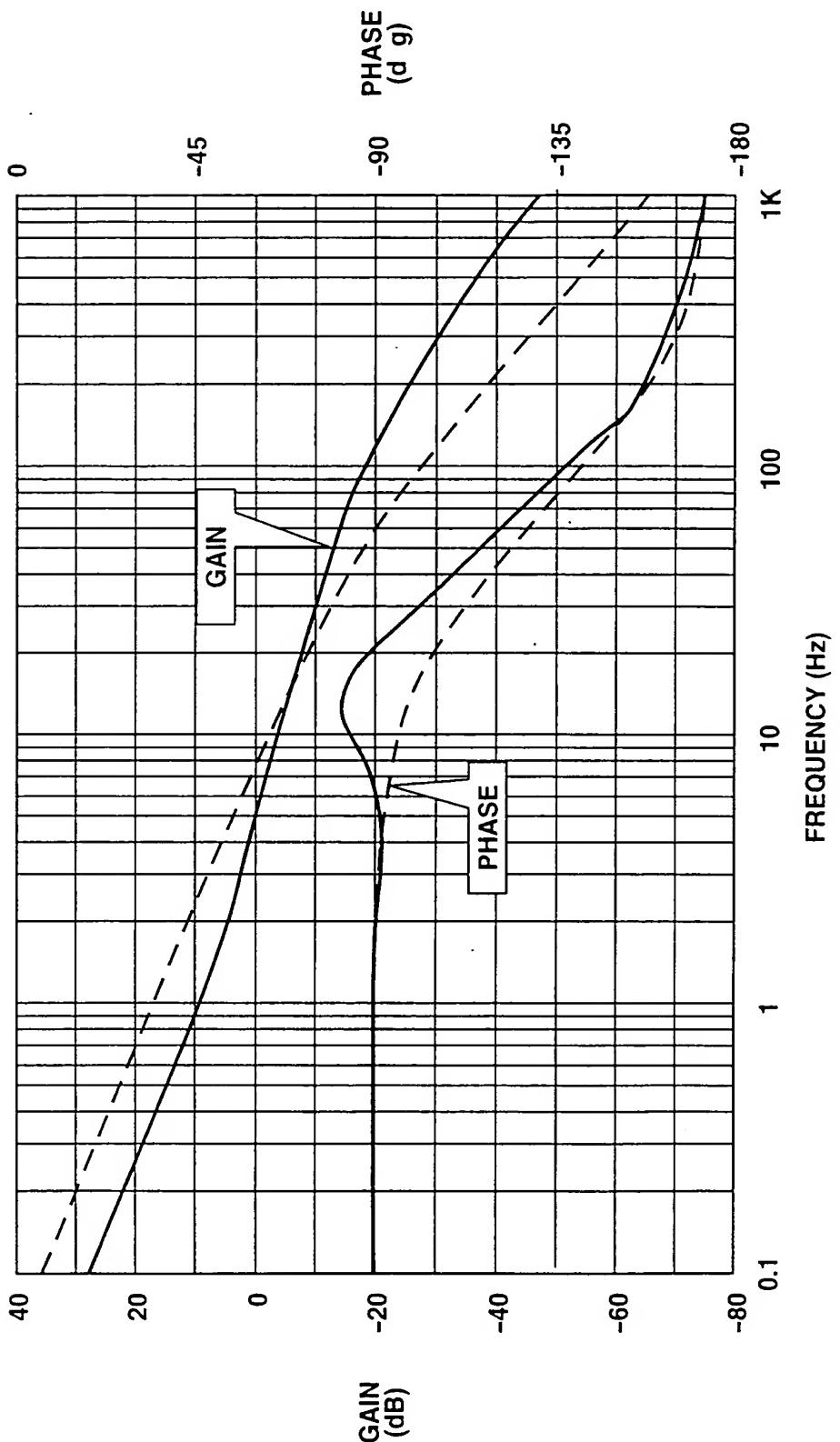


FIG.13

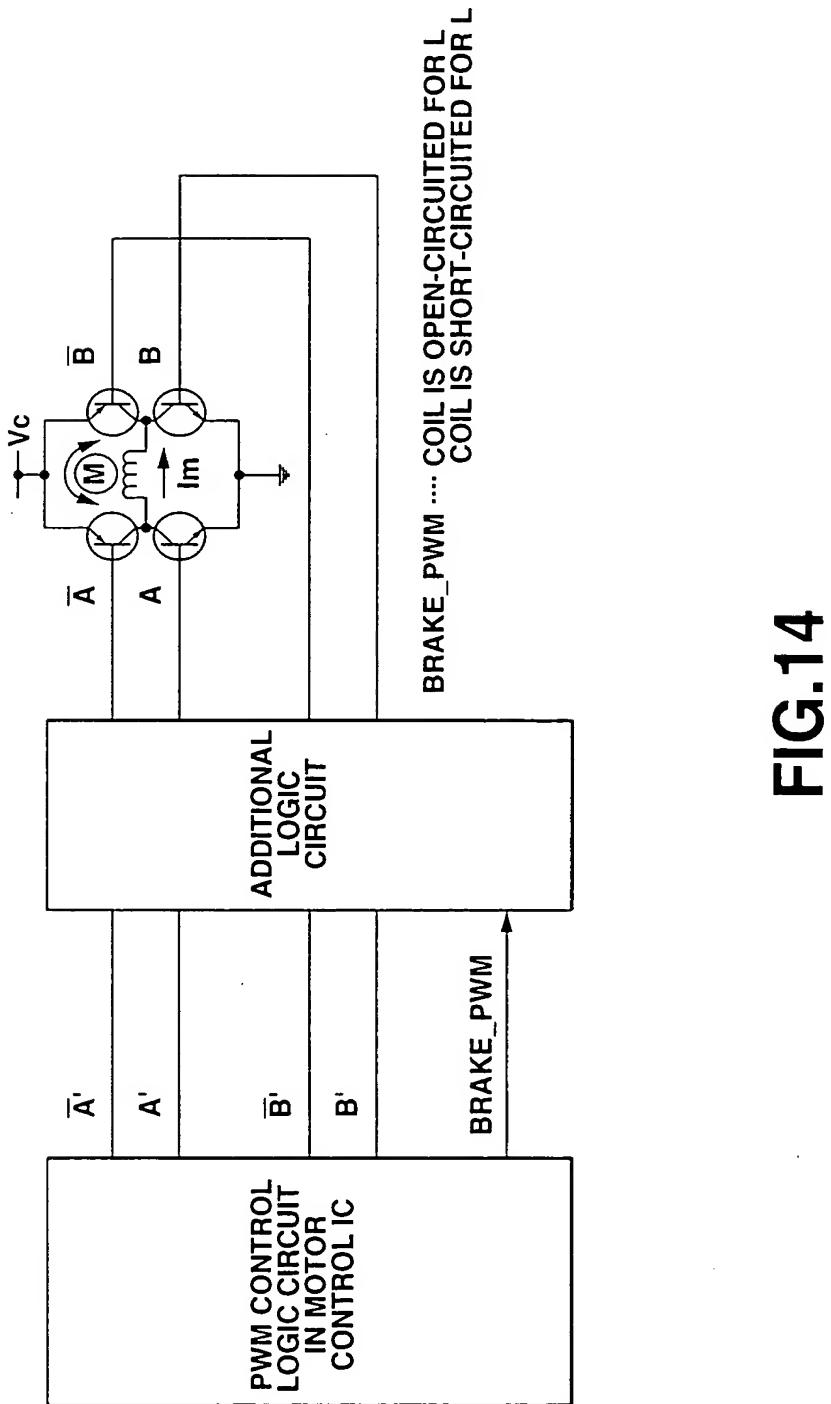


FIG.14

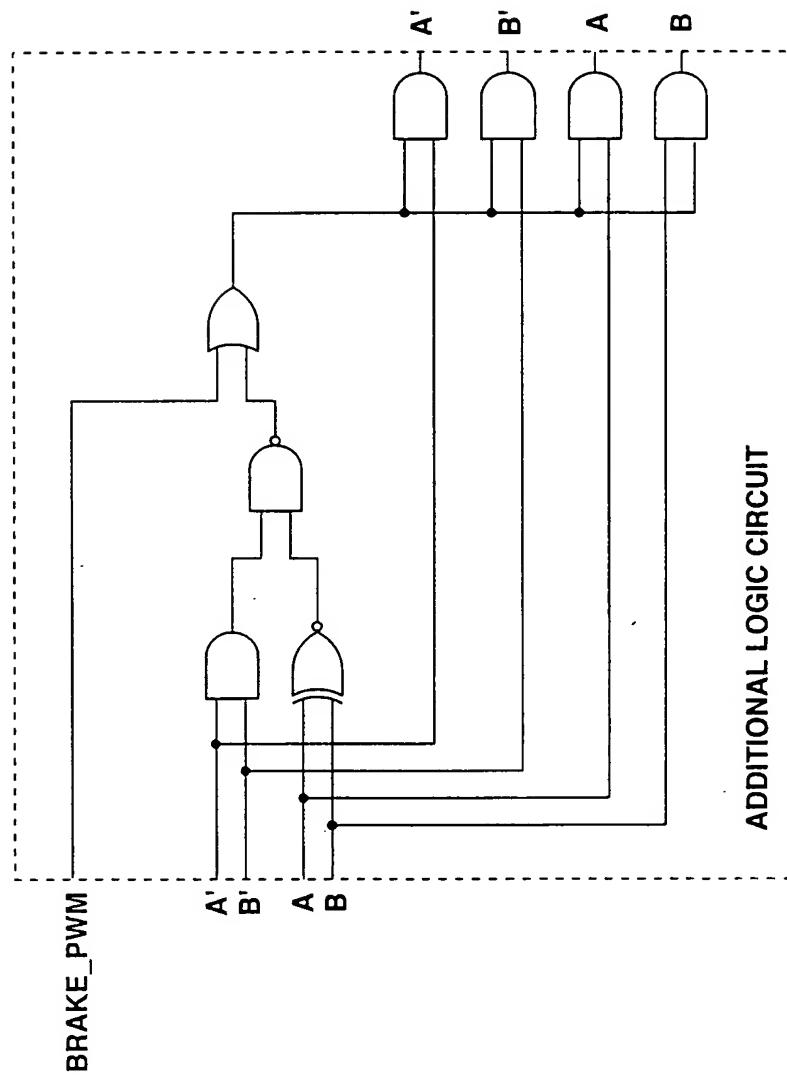
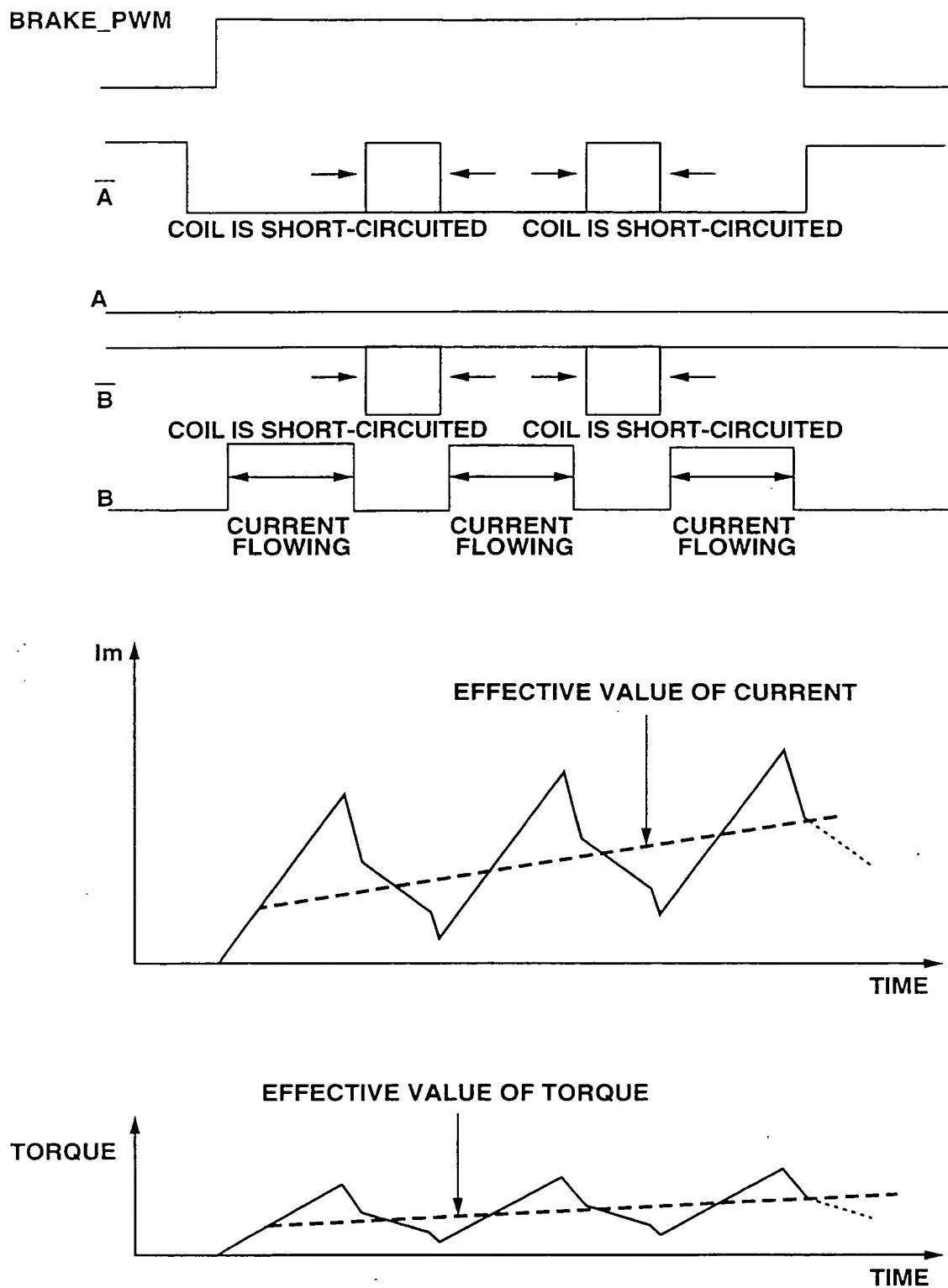


FIG. 15



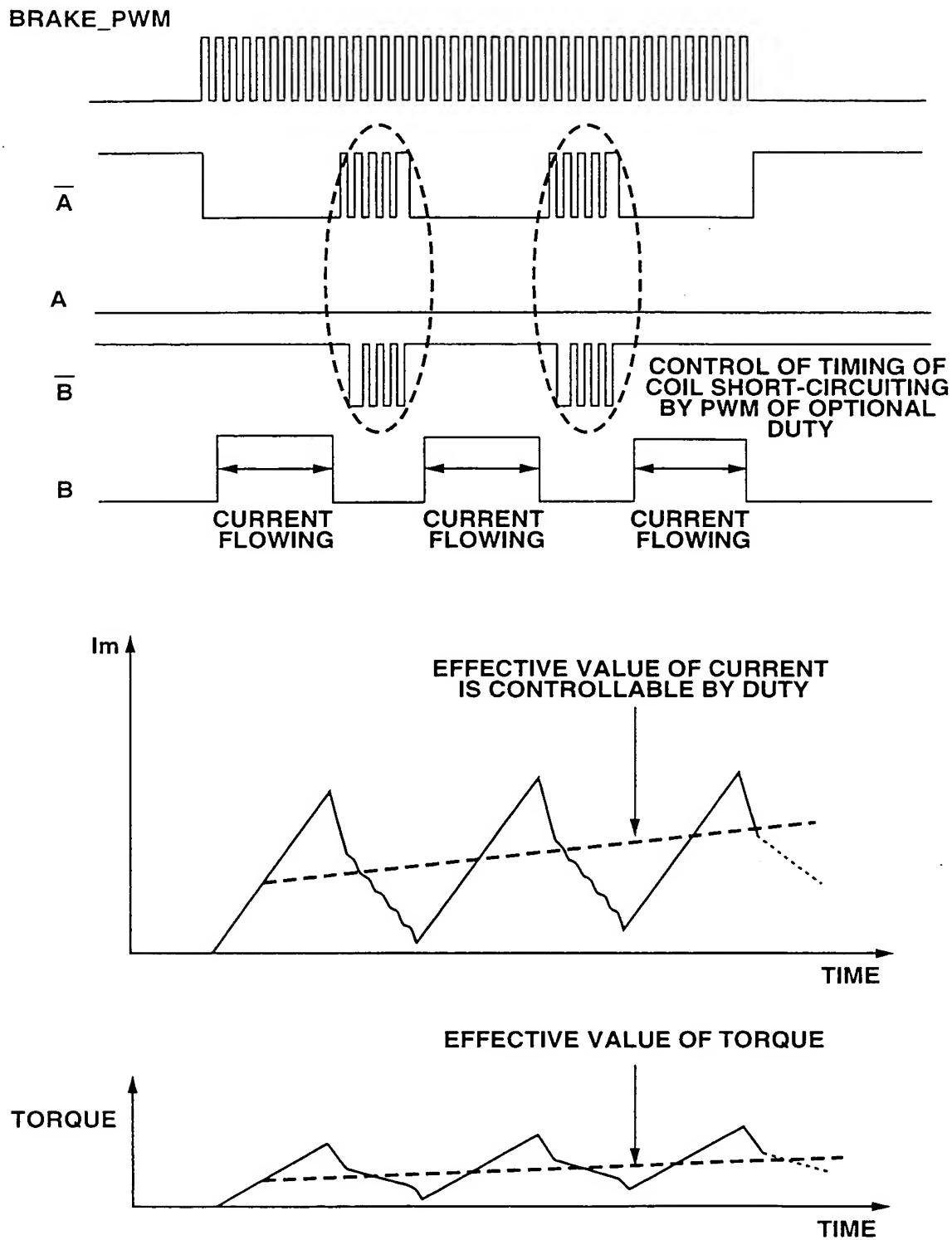


FIG.17

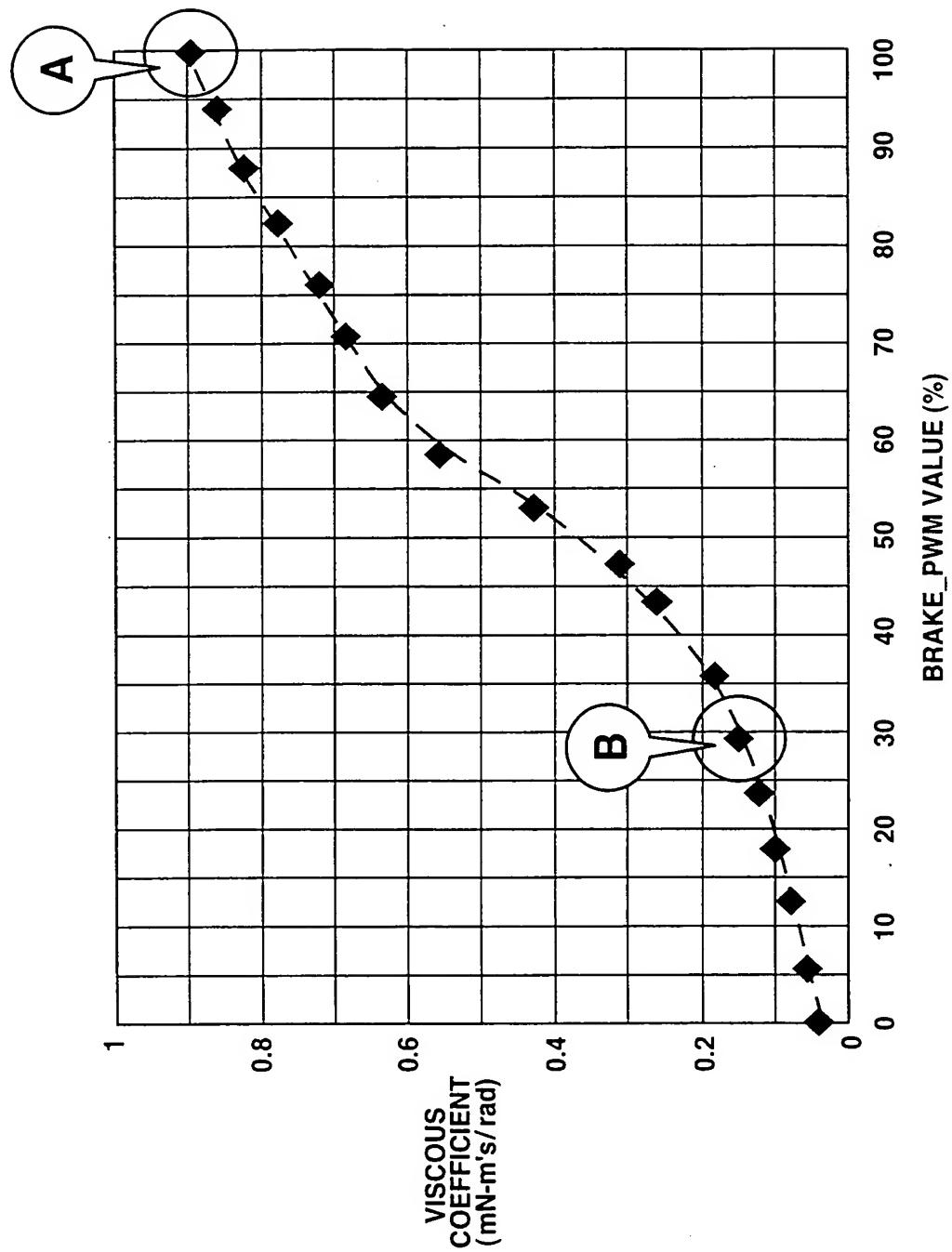


FIG. 18

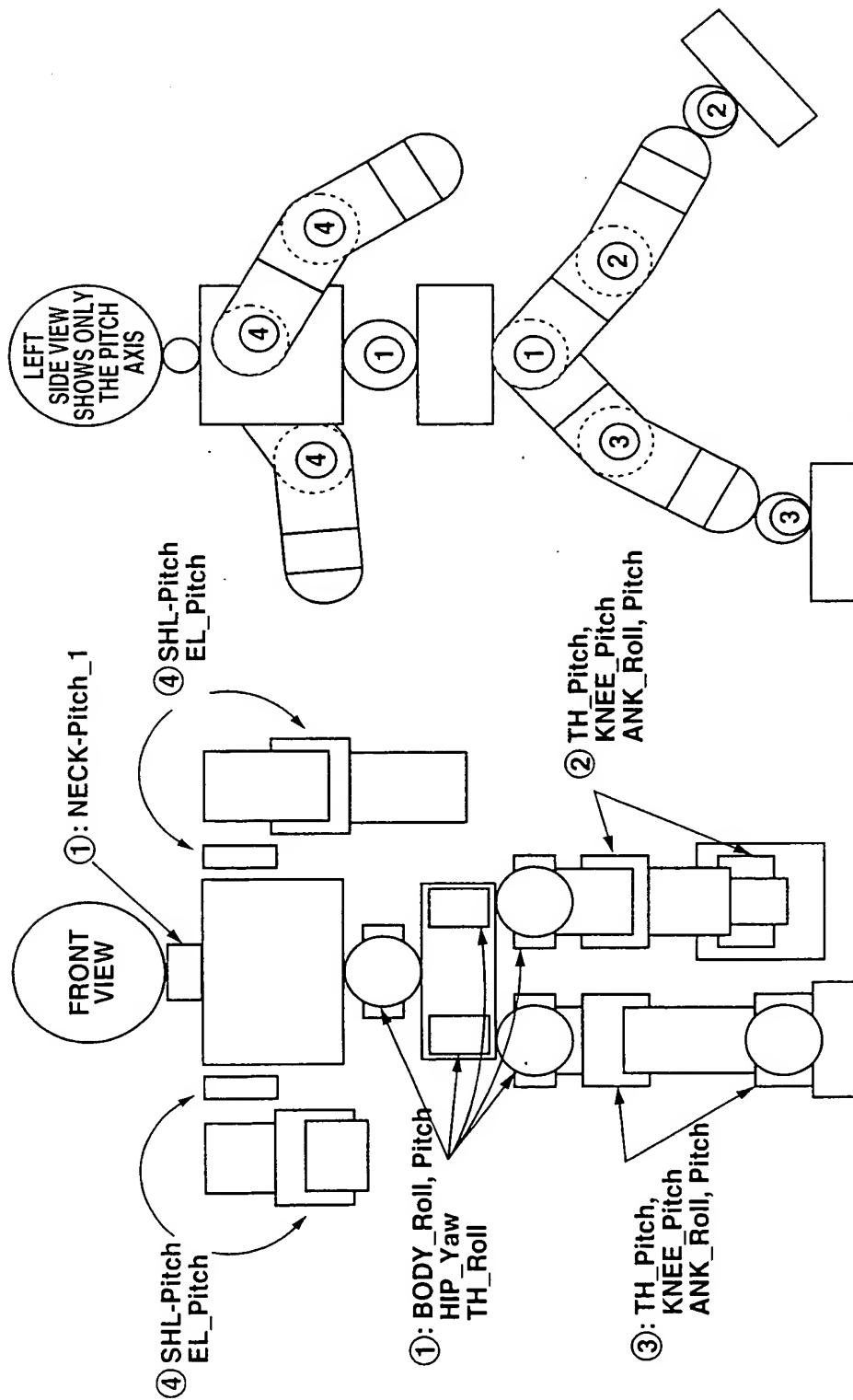


FIG.19

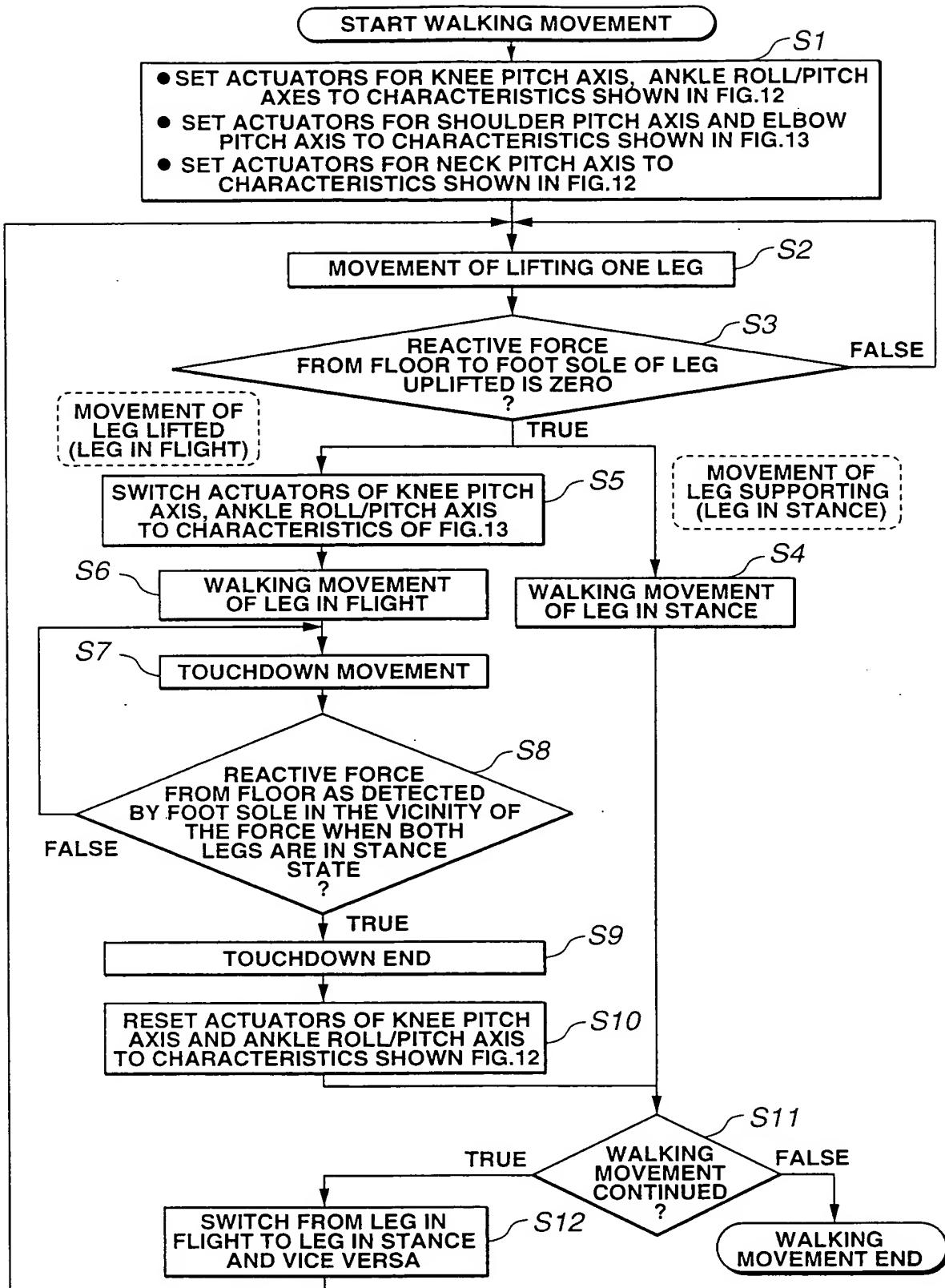


FIG.20

LOWER LIMBS (BOTH LEGS) AND FLOOR SURFACE DEFINE
CLOSED LINK DURING UPSTANDING OF THE ROBOT

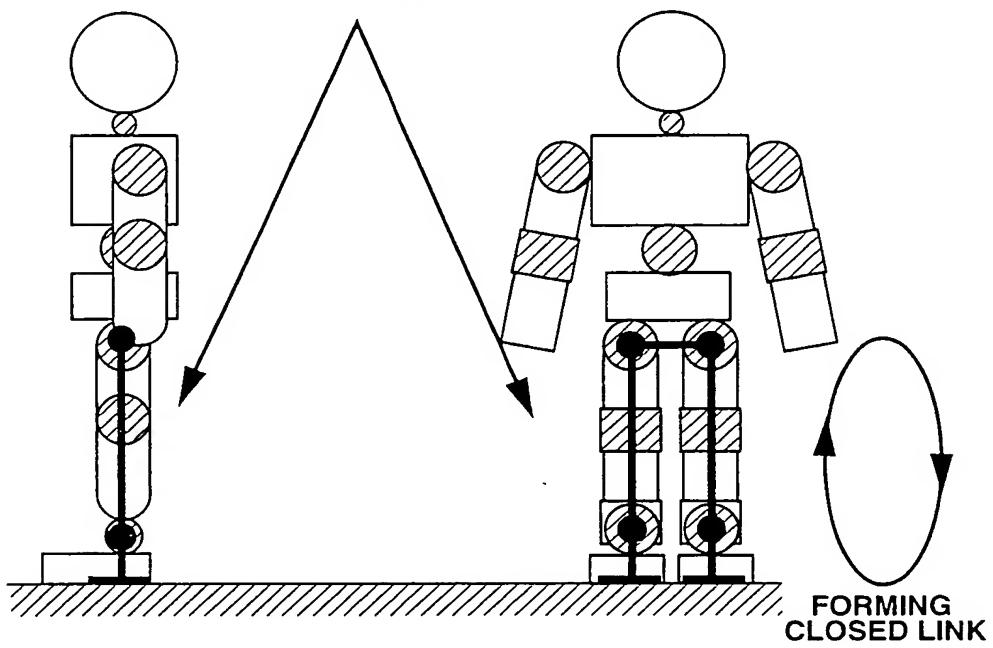


FIG.21

LOWER LIMBS (BOTH LEGS) AND FLOOR SURFACE DEFINE
OPEN LINK DURING UPSTANDING OF THE ROBOT

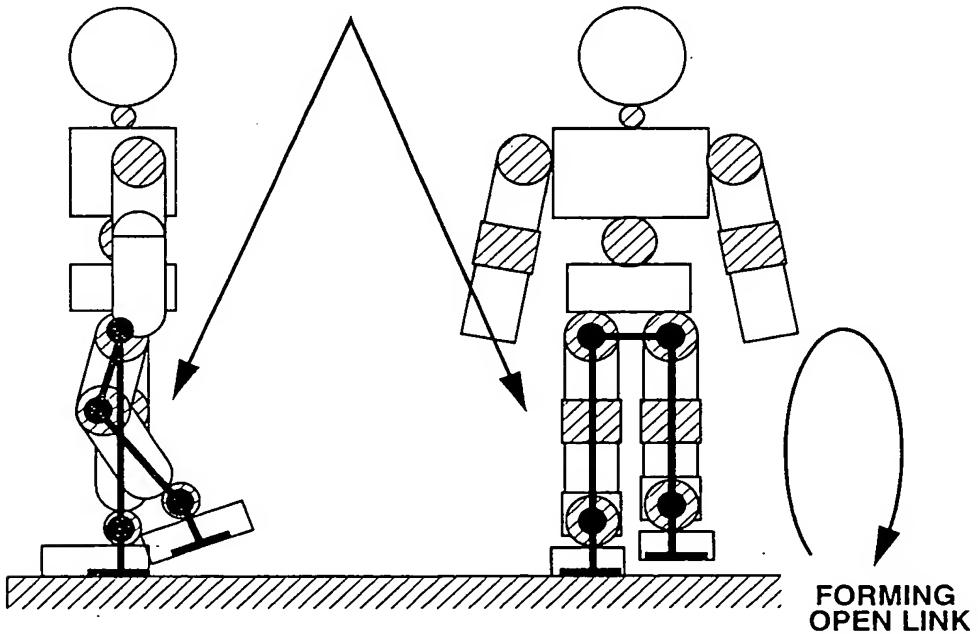


FIG.22

STIFF JOINT
CHARACTERISTICS

SERVO CHARACTERISTICS
(FIG.12)

JOINT VISCOSITY
(FIG.18A)

INTERMEDIATE JOINT
CHARACTERISTICS

SERVO CHARACTERISTICS
(FIG.13)

JOINT VISCOSITY
(FIG.18A)

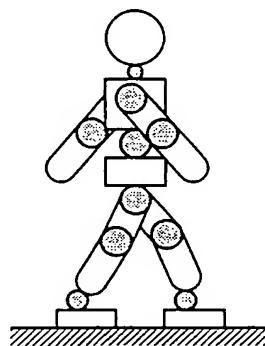
SOFT JOINT
CHARACTERISTICS

SERVO CHARACTERISTICS
(FIG.13)

JOINT VISCOSITY
(FIG.18B)

TIME PERIOD WHEN BOTH
LEGS ARE IN STANCE

LOWER LIMBS FORM
A CLOSED LINK SYSTEM
WITH FLOOR SURFACE



RIGHT	SHOULDER PITCH	STIFF JOINT CHARACTERISTICS	
	ELBOW PITCH	STIFF JOINT CHARACTERISTICS	
	THIGH ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
LEFT	SHOULDER PITCH	STIFF JOINT CHARACTERISTICS	
	ELBOW PITCH	STIFF JOINT CHARACTERISTICS	
	THIGH ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.23

STIFF JOINT CHARACTERISTICS	
SERVO CHARACTERISTICS (FIG.12)	
JOINT VISCOSITY (FIG.18A)	
INTERMEDIATE JOINT CHARACTERISTICS	
SERVO CHARACTERISTICS (FIG.13)	
JOINT VISCOSITY (FIG.18A)	
SOFT JOINT CHARACTERISTICS	
SERVO CHARACTERISTICS (FIG.13)	
JOINT VISCOSITY (FIG.18B)	

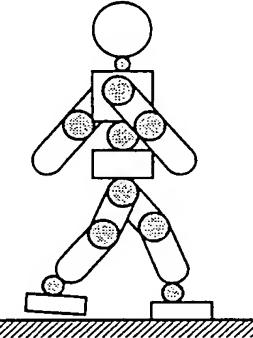
INSTANT OF CLEARING THE FLOOR			
ROBOT BODY (LEGS, BODY TRUNK AND ARMS) FORMS A CLOSED LINK SYSTEM WITH FLOOR SURFACE			
			
	SHOULDER PITCH	STIFF JOINT CHARACTERISTICS	
	ELBOW PITCH	STIFF JOINT CHARACTERISTICS	
RIGHT	THIGH ROLL	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
LEFT	SHOULDER PITCH	STIFF JOINT CHARACTERISTICS	
	ELBOW PITCH	STIFF JOINT CHARACTERISTICS	
	THIGH ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.24

STIFF JOINT
CHARACTERISTICS

SERVO CHARACTERISTICS
(FIG.12)

JOINT VISCOSITY
(FIG.18A)

INTERMEDIATE JOINT
CHARACTERISTICS

SERVO CHARACTERISTICS
(FIG.13)

JOINT VISCOSITY
(FIG.18A)

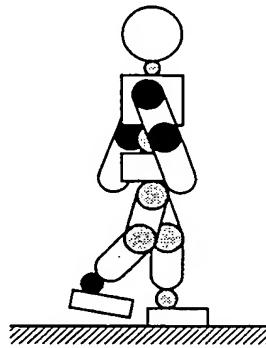
SOFT JOINT
CHARACTERISTICS

SERVO CHARACTERISTICS
(FIG.13)

JOINT VISCOSITY
(FIG.18B)

TIME PERIOD WHEN A SOLE
LEG IS IN STANCE
(ANOTHER LEG BEING LIFTED)

ROBOT BODY (LEGS, BODY
TRUNK AND ARMS) FORMS
A CLOSED LINK SYSTEM
WITH FLOOR SURFACE



SHOULDER PITCH

SOFT JOINT
CHARACTERISTICS

ELBOW PITCH

SOFT JOINT
CHARACTERISTICS

THIGH ROLL

LEG IN
FLIGHT

STIFF JOINT
CHARACTERISTICS

THIGH PITCH

LEG IN
FLIGHT

STIFF JOINT
CHARACTERISTICS

KNEE PITCH

LEG IN
FLIGHT

INTERMEDIATE JOINT
CHARACTERISTICS

ANKLE ROLL

LEG IN
FLIGHT

SOFT JOINT
CHARACTERISTICS

ANKLE PITCH

LEG IN
FLIGHT

SOFT JOINT
CHARACTERISTICS

SHOULDER PITCH

STIFF JOINT
CHARACTERISTICS

ELBOW PITCH

STIFF JOINT
CHARACTERISTICS

THIGH ROLL

LEG IN
STANCE

STIFF JOINT
CHARACTERISTICS

THIGH PITCH

LEG IN
STANCE

STIFF JOINT
CHARACTERISTICS

KNEE PITCH

LEG IN
STANCE

STIFF JOINT
CHARACTERISTICS

ANKLE ROLL

LEG IN
STANCE

STIFF JOINT
CHARACTERISTICS

ANKLE PITCH

LEG IN
STANCE

STIFF JOINT
CHARACTERISTICS

OTHER JOINT SITES

STIFF JOINT
CHARACTERISTICS

FIG.25

<u>STIFF JOINT CHARACTERISTICS</u>		
SERVO CHARACTERISTICS (FIG.12)	TIME PERIOD WHEN A SOLE LEG IS IN STANCE (ANOTHER LEG BEING SWUNG DOWN)	
JOINT VISCOSITY (FIG.18A)	ROBOT BODY (LEGS, BODY TRUNK AND ARMS) FORMS A CLOSED LINK SYSTEM WITH FLOOR SURFACE	
<u>INTERMEDIATE JOINT CHARACTERISTICS</u>		
SERVO CHARACTERISTICS (FIG.13)		
JOINT VISCOSITY (FIG.18A)		
<u>SOFT JOINT CHARACTERISTICS</u>		
SERVO CHARACTERISTICS (FIG.13)		
JOINT VISCOSITY (FIG.18B)		
RIGHT	SHOULDER PITCH	SOFT JOINT CHARACTERISTICS
	ELBOW PITCH	SOFT JOINT CHARACTERISTICS
	THIGH ROLL	LEG IN FLIGHT STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN FLIGHT STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN FLIGHT SOFT JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN FLIGHT SOFT JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN FLIGHT SOFT JOINT CHARACTERISTICS
LEFT	SHOULDER PITCH	STIFF JOINT CHARACTERISTICS
	ELBOW PITCH	STIFF JOINT CHARACTERISTICS
	THIGH ROLL	LEG IN STANCE STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE STIFF JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE STIFF JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE STIFF JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS

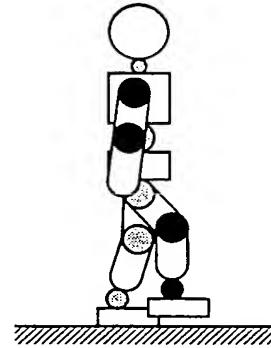
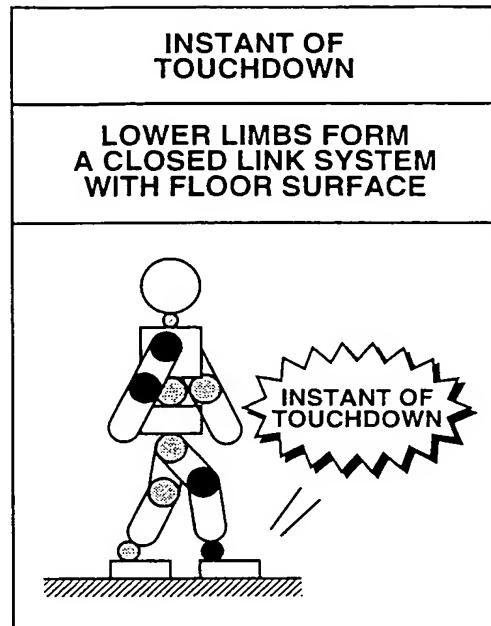


FIG.26

STIFF JOINT CHARACTERISTICS
SERVO CHARACTERISTICS (FIG.12)
JOINT VISCOSITY (FIG.18A)

INTERMEDIATE JOINT CHARACTERISTICS
SERVO CHARACTERISTICS (FIG.13)
JOINT VISCOSITY (FIG.18A)

SOFT JOINT CHARACTERISTICS
SERVO CHARACTERISTICS (FIG.13)
JOINT VISCOSITY (FIG.18B)



RIGHT	SHOULDER PITCH	SOFT JOINT CHARACTERISTICS	
	ELBOW PITCH	SOFT JOINT CHARACTERISTICS	
	THIGH ROLL	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
LEFT	SHOULDER PITCH	STIFF JOINT CHARACTERISTICS	
	ELBOW PITCH	STIFF JOINT CHARACTERISTICS	
	THIGH ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.27

STIFF JOINT
CHARACTERISTICS

SERVO CHARACTERISTICS
(FIG.12)

JOINT VISCOSITY
(FIG.18A)

INTERMEDIATE JOINT
CHARACTERISTICS

SERVO CHARACTERISTICS
(FIG.13)

JOINT VISCOSITY
(FIG.18A)

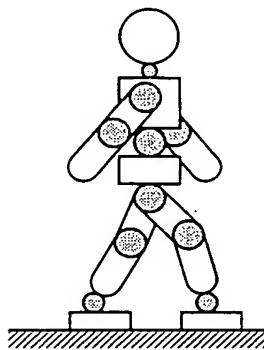
SOFT JOINT
CHARACTERISTICS

SERVO CHARACTERISTICS
(FIG.13)

JOINT VISCOSITY
(FIG.18B)

TIME PERIOD WHEN BOTH
LEGS ARE IN STANCE

LOWER LIMBS FORM
A CLOSED LINK SYSTEM
WITH FLOOR SURFACE



SHOULDER PITCH

STIFF JOINT
CHARACTERISTICS

ELBOW PITCH

STIFF JOINT
CHARACTERISTICS

THIGH ROLL

LEG IN
STANCE

INTERMEDIATE JOINT
CHARACTERISTICS

THIGH PITCH

LEG IN
STANCE

INTERMEDIATE JOINT
CHARACTERISTICS

KNEE PITCH

LEG IN
STANCE

INTERMEDIATE JOINT
CHARACTERISTICS

ANKLE ROLL

LEG IN
STANCE

INTERMEDIATE JOINT
CHARACTERISTICS

ANKLE PITCH

LEG IN
STANCE

INTERMEDIATE JOINT
CHARACTERISTICS

SHOULDER PITCH

STIFF JOINT
CHARACTERISTICS

ELBOW PITCH

STIFF JOINT
CHARACTERISTICS

THIGH ROLL

LEG IN
STANCE

INTERMEDIATE JOINT
CHARACTERISTICS

THIGH PITCH

LEG IN
STANCE

INTERMEDIATE JOINT
CHARACTERISTICS

KNEE PITCH

LEG IN
STANCE

INTERMEDIATE JOINT
CHARACTERISTICS

ANKLE ROLL

LEG IN
STANCE

INTERMEDIATE JOINT
CHARACTERISTICS

ANKLE PITCH

LEG IN
STANCE

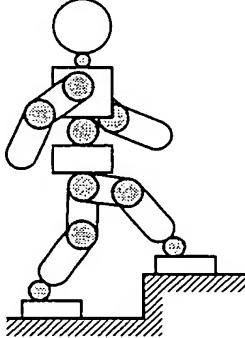
INTERMEDIATE JOINT
CHARACTERISTICS

OTHER JOINT SITES

STIFF JOINT
CHARACTERISTICS

FIG.28

STIFF JOINT CHARACTERISTICS	
SERVO CHARACTERISTICS (FIG.12)	
JOINT VISCOSITY (FIG.18A)	
INTERMEDIATE JOINT CHARACTERISTICS	
SERVO CHARACTERISTICS (FIG.13)	
JOINT VISCOSITY (FIG.18A)	
SOFT JOINT CHARACTERISTICS	
SERVO CHARACTERISTICS (FIG.13)	
JOINT VISCOSITY (FIG.18B)	

TIME PERIOD WHEN BOTH LEGS ARE IN STANCE
LOWER LIMBS FORM A CLOSED LINK SYSTEM WITH FLOOR SURFACE


RIGHT	THIGH ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
LEFT	THIGH ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.29

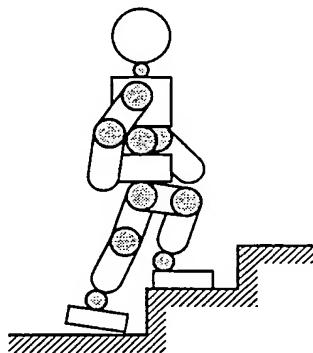
STIFF JOINT CHARACTERISTICS
SERVO CHARACTERISTICS (FIG.12)
JOINT VISCOSITY (FIG.18A)

INTERMEDIATE JOINT CHARACTERISTICS
SERVO CHARACTERISTICS (FIG.13)
JOINT VISCOSITY (FIG.18A)

SOFT JOINT CHARACTERISTICS
SERVO CHARACTERISTICS (FIG.13)
JOINT VISCOSITY (FIG.18B)

INSTANT OF CLEARING THE FLOOR

TRANSITION FROM CLOSED LINK SYSTEM TO OPEN LINK SYSTEM



RIGHT	THIGH ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
LEFT	THIGH ROLL	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.30

<u>STIFF JOINT CHARACTERISTICS</u>			
SERVO CHARACTERISTICS (FIG.12)			
JOINT VISCOSITY (FIG.18A)			
<u>INTERMEDIATE JOINT CHARACTERISTICS</u>			
SERVO CHARACTERISTICS (FIG.13)			
JOINT VISCOSITY (FIG.18A)			
<u>SOFT JOINT CHARACTERISTICS</u>			
SERVO CHARACTERISTICS (FIG.13)			
JOINT VISCOSITY (FIG.18B)			
RIGHT	THIGH ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
LEFT	THIGH ROLL	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

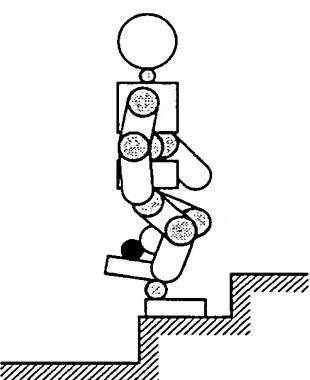
<u>TIME PERIOD WHEN A SOLE LEG IS IN STANCE (ANOTHER LEG BEING LIFTED)</u>
ROBOT BODY (LEGS, BODY TRUNK AND ARMS) FORMS AN OPEN LINK SYSTEM WITH FLOOR SURFACE


FIG.31

<u>STIFF JOINT CHARACTERISTICS</u>			
SERVO CHARACTERISTICS (FIG.12)			
JOINT VISCOSITY (FIG.18A)			
<u>INTERMEDIATE JOINT CHARACTERISTICS</u>			
SERVO CHARACTERISTICS (FIG.13)			
JOINT VISCOSITY (FIG.18A)			
<u>SOFT JOINT CHARACTERISTICS</u>			
SERVO CHARACTERISTICS (FIG.13)			
JOINT VISCOSITY (FIG.18B)			
RIGHT	THIGH ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
LEFT	THIGH ROLL	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

TIME PERIOD WHEN A SOLE LEG IS IN STANCE (ANOTHER LEG BEING SWUNG DOWN)

ROBOT BODY (LEGS, BODY TRUNK AND ARMS) FORMS AN OPEN LINK SYSTEM WITH FLOOR SURFACE

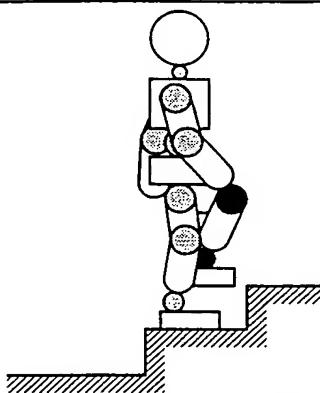


FIG.32

STIFF JOINT CHARACTERISTICS
SERVO CHARACTERISTICS (FIG.12)
JOINT VISCOSITY (FIG.18A)

INTERMEDIATE JOINT CHARACTERISTICS
SERVO CHARACTERISTICS (FIG.13)
JOINT VISCOSITY (FIG.18A)

SOFT JOINT CHARACTERISTICS
SERVO CHARACTERISTICS (FIG.13)
JOINT VISCOSITY (FIG.18B)

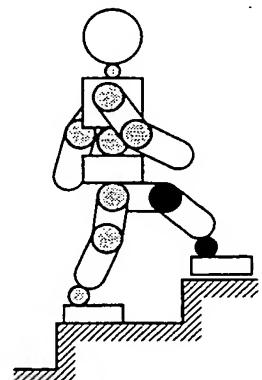
<p>INSTANT OF TOUCHDOWN</p> <p>LOWER LIMBS FORM A CLOSED LINK SYSTEM WITH FLOOR SURFACE</p> 			
RIGHT	THIGH ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
LEFT	THIGH ROLL	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.33

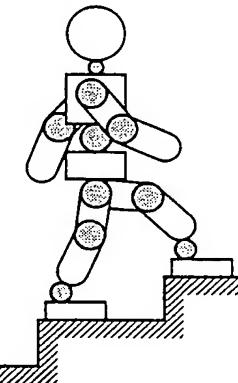
**STIFF JOINT
CHARACTERISTICS**
 SERVO CHARACTERISTICS
(FIG.12)
 JOINT VISCOSITY
(FIG.18A)

**INTERMEDIATE JOINT
CHARACTERISTICS**
 SERVO CHARACTERISTICS
(FIG.13)
 JOINT VISCOSITY
(FIG.18A)

**SOFT JOINT
CHARACTERISTICS**
 SERVO CHARACTERISTICS
(FIG.13)
 JOINT VISCOSITY
(FIG.18B)

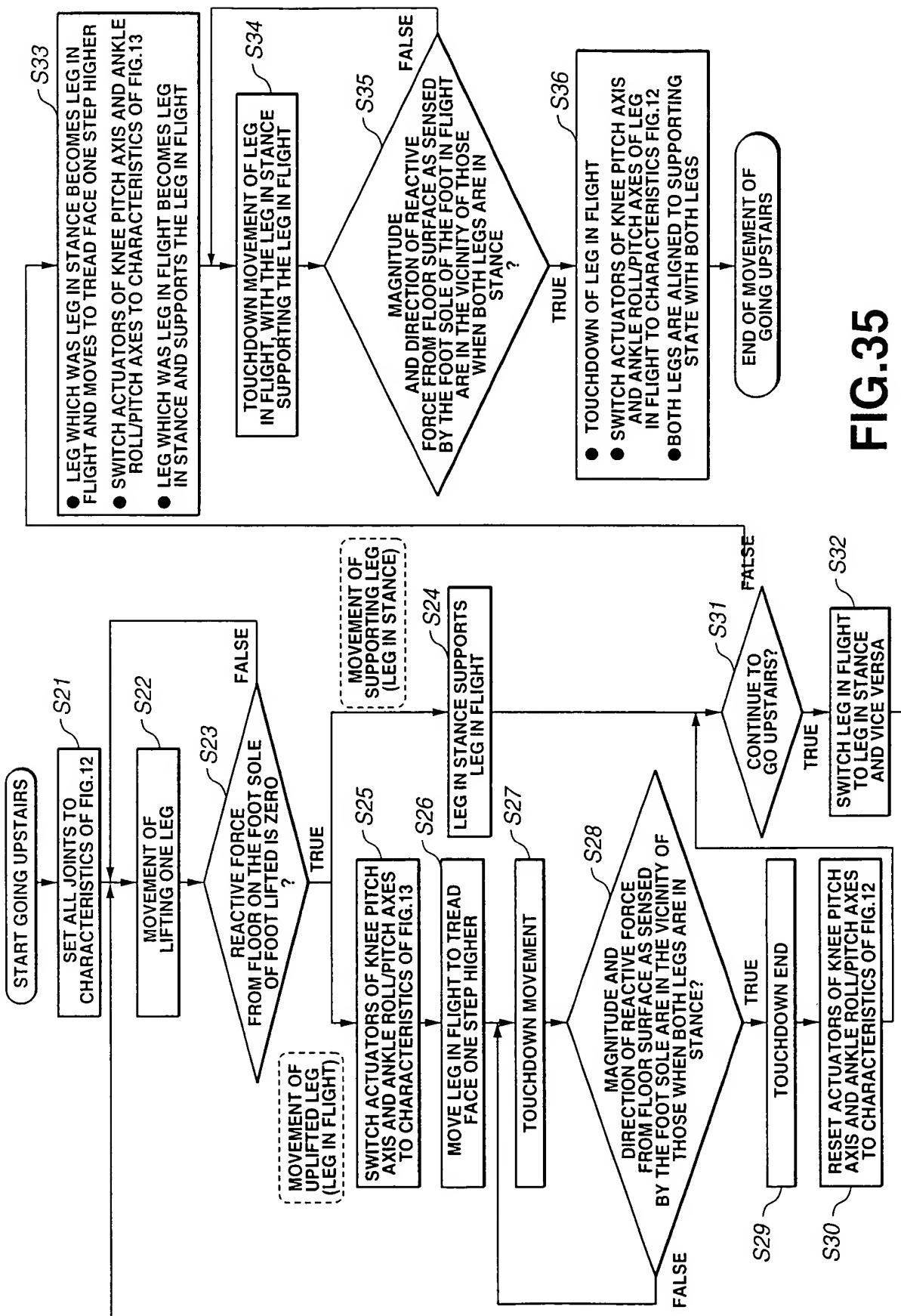
TIME PERIOD WHEN BOTH
LEGS ARE IN STANCE

LOWER LIMBS FORM
A CLOSED LINK SYSTEM
WITH FLOOR SURFACE



RIGHT	THIGH ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
LEFT	THIGH ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.34



STIFF JOINT
CHARACTERISTICS

SERVO CHARACTERISTICS
(FIG.12)

JOINT VISCOSITY
(FIG.18A)

INTERMEDIATE JOINT
CHARACTERISTICS

SERVO CHARACTERISTICS
(FIG.13)

JOINT VISCOSITY
(FIG.18A)

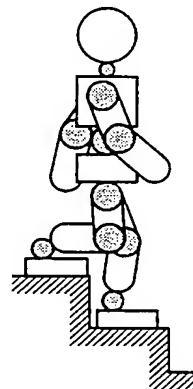
SOFT JOINT
CHARACTERISTICS

SERVO CHARACTERISTICS
(FIG.13)

JOINT VISCOSITY
(FIG.18B)

TIME PERIOD WHEN BOTH
LEGS ARE IN STANCE

LOWER LIMBS FORM
A CLOSED LINK SYSTEM
WITH FLOOR SURFACE



RIGHT	THIGH ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
LEFT	THIGH ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.36

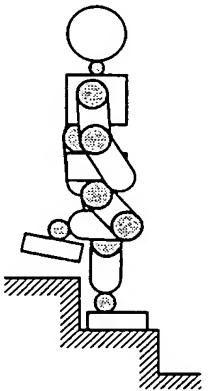
<u>STIFF JOINT CHARACTERISTICS</u>						
SERVO CHARACTERISTICS (FIG.12)						
JOINT VISCOSITY (FIG.18A)						
<u>INTERMEDIATE JOINT CHARACTERISTICS</u>						
SERVO CHARACTERISTICS (FIG.13)						
JOINT VISCOSITY (FIG.18A)						
<u>SOFT JOINT CHARACTERISTICS</u>						
SERVO CHARACTERISTICS (FIG.13)						
JOINT VISCOSITY (FIG.18B)						
INSTANT OF CLEARING THE FLOOR						
ROBOT BODY (LEGS, BODY TRUNK AND ARMS) FORMS AN OPEN LINK SYSTEM WITH FLOOR SURFACE						
						
RIGHT	THIGH ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS			
	THIGH PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS			
	KNEE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS			
	ANKLE ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS			
	ANKLE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS			
LEFT	THIGH ROLL	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS			
	THIGH PITCH	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS			
	KNEE PITCH	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS			
	ANKLE ROLL	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS			
	ANKLE PITCH	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS			
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS				

FIG.37

STIFF JOINT CHARACTERISTICS	SERVO CHARACTERISTICS (FIG.12)	TIME PERIOD WHEN A SOLE LEG IS IN STANCE (ANOTHER LEG BEING LIFTED)
	JOINT VISCOSITY (FIG.18A)	ROBOT BODY (LEGS, BODY TRUNK AND ARMS) FORMS A CLOSED LINK SYSTEM WITH FLOOR SURFACE
INTERMEDIATE JOINT CHARACTERISTICS	SERVO CHARACTERISTICS (FIG.13)	
	JOINT VISCOSITY (FIG.18A)	
SOFT JOINT CHARACTERISTICS	SERVO CHARACTERISTICS (FIG.13)	
	JOINT VISCOSITY (FIG.18B)	

RIGHT	THIGH ROLL	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN FLIGHT	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
LEFT	THIGH ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

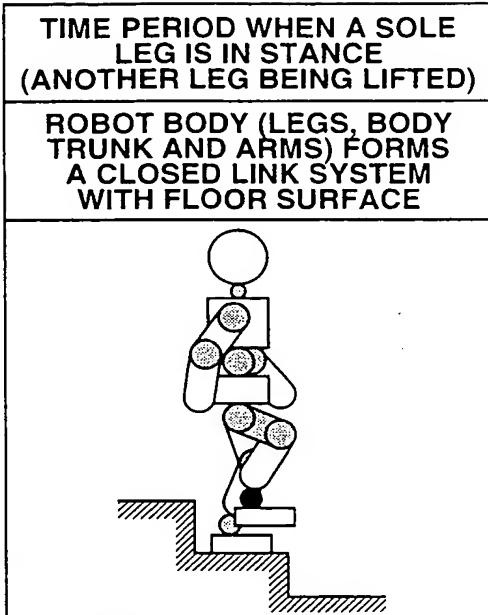


FIG.38

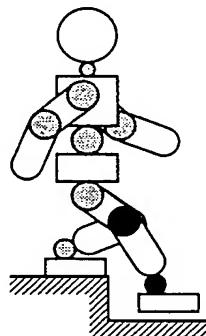
STIFF JOINT CHARACTERISTICS
SERVO CHARACTERISTICS (FIG.12)
JOINT VISCOSITY (FIG.18A)

INTERMEDIATE JOINT CHARACTERISTICS
SERVO CHARACTERISTICS (FIG.13)
JOINT VISCOSITY (FIG.18A)

SOFT JOINT CHARACTERISTICS
SERVO CHARACTERISTICS (FIG.13)
JOINT VISCOSITY (FIG.18B)

TIME PERIOD WHEN A SOLE LEG IS IN STANCE (ANOTHER LEG BEING SWUNG DOWN)

ROBOT BODY (LEGS, BODY TRUNK AND ARMS) FORMS AN OPEN LINK SYSTEM WITH FLOOR SURFACE



RIGHT	THIGH ROLL	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
LEFT	THIGH ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.39

**STIFF JOINT
CHARACTERISTICS**
**SERVO CHARACTERISTICS
(FIG.12)**
**JOINT VISCOSITY
(FIG.18A)**

**INTERMEDIATE JOINT
CHARACTERISTICS**
**SERVO CHARACTERISTICS
(FIG.13)**
**JOINT VISCOSITY
(FIG.18A)**

**SOFT JOINT
CHARACTERISTICS**
**SERVO CHARACTERISTICS
(FIG.13)**
**JOINT VISCOSITY
(FIG.18B)**

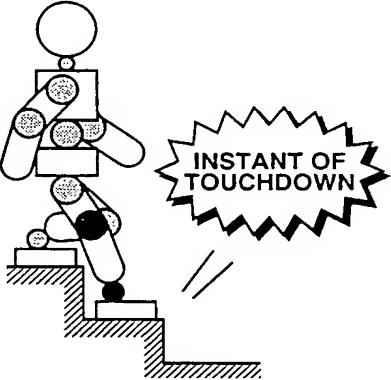
INSTANT OF TOUCHDOWN LOWER LIMBS FORM A CLOSED LINK SYSTEM WITH FLOOR SURFACE			
			
	THIGH ROLL	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
RIGHT	KNEE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	THIGH ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
LEFT	THIGH PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.40

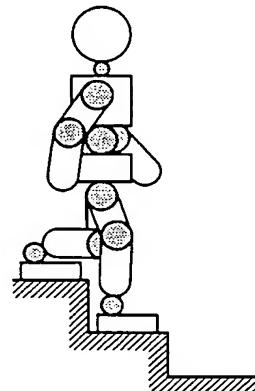
STIFF JOINT CHARACTERISTICS
SERVO CHARACTERISTICS (FIG.12)
JOINT VISCOSITY (FIG.18A)

INTERMEDIATE JOINT CHARACTERISTICS
SERVO CHARACTERISTICS (FIG.13)
JOINT VISCOSITY (FIG.18A)

SOFT JOINT CHARACTERISTICS
SERVO CHARACTERISTICS (FIG.13)
JOINT VISCOSITY (FIG.18B)

TIME PERIOD WHEN BOTH LEGS ARE IN STANCE

LOWER LIMBS FORM A CLOSED LINK SYSTEM WITH FLOOR SURFACE



RIGHT	THIGH ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
LEFT	THIGH ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.41

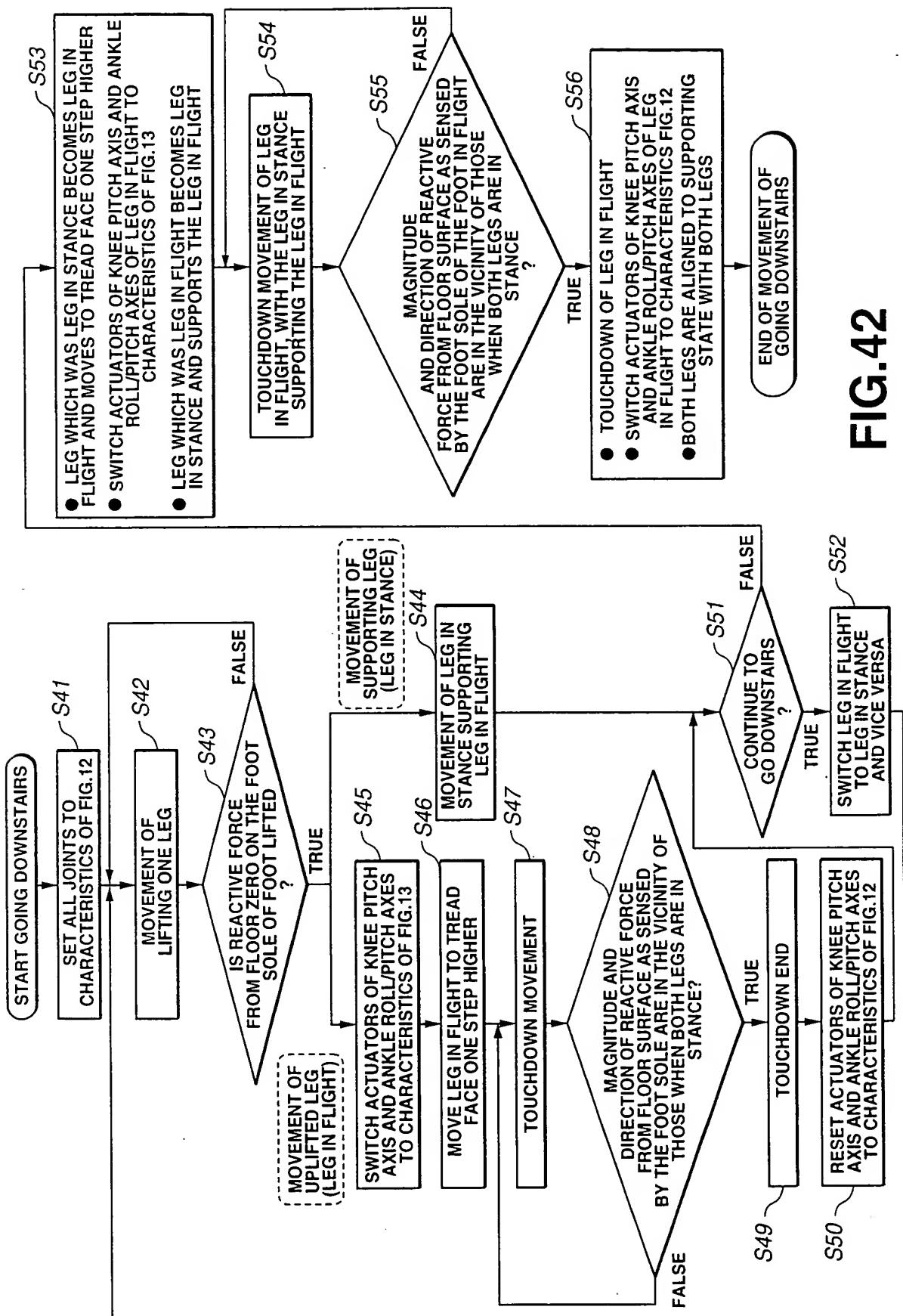


FIG.42

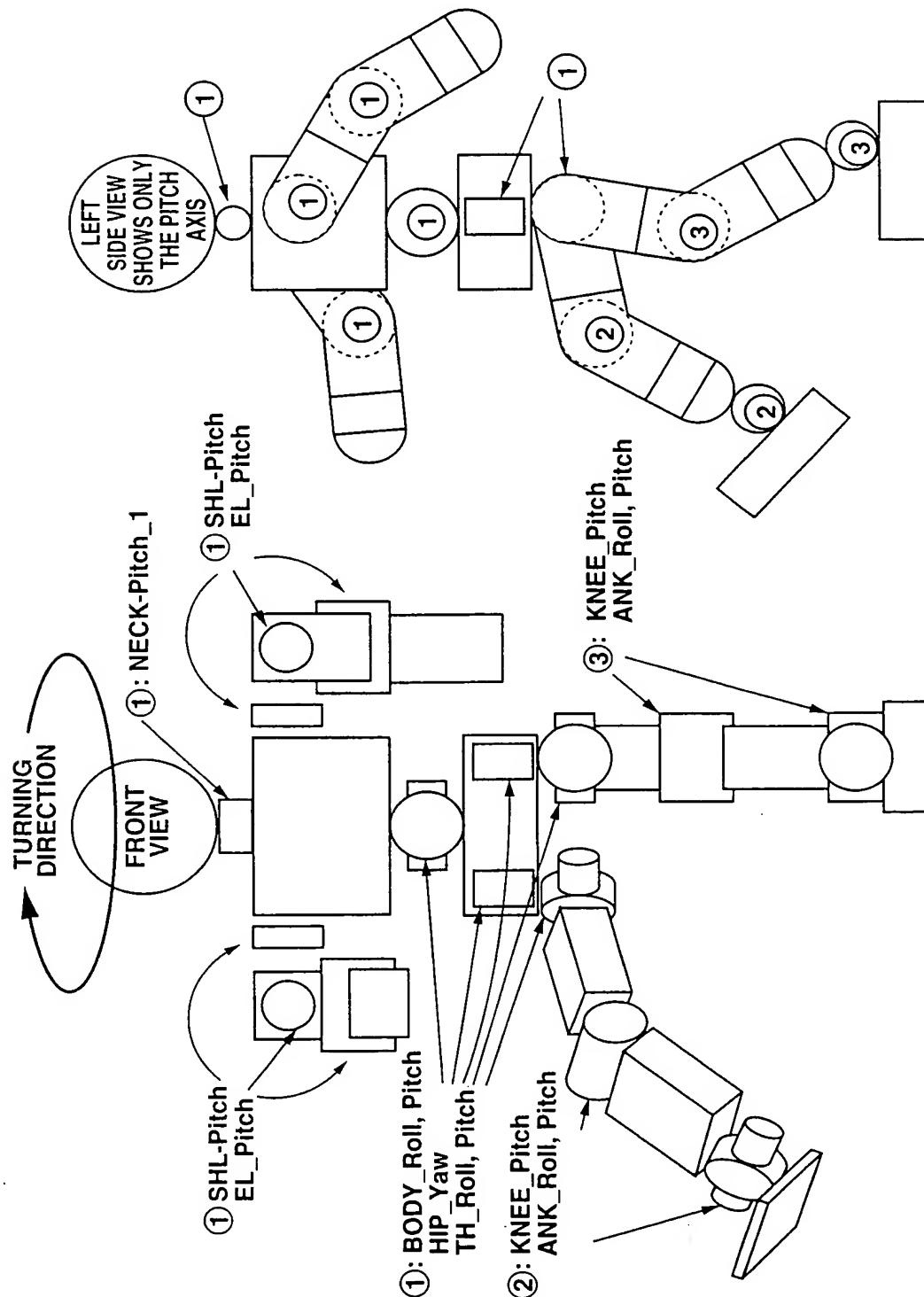


FIG.43

<u>STIFF JOINT CHARACTERISTICS</u>			
SERVO CHARACTERISTICS (FIG.12)	<u>TIME PERIOD WHEN BOTH LEGS ARE IN STANCE</u>		
JOINT VISCOSITY (FIG.18A)	<u>LOWER LIMBS FORM A CLOSED LINK SYSTEM WITH FLOOR SURFACE</u>		
<u>INTERMEDIATE JOINT CHARACTERISTICS</u>			
SERVO CHARACTERISTICS (FIG.13)			
JOINT VISCOSITY (FIG.18A)			
<u>SOFT JOINT CHARACTERISTICS</u>			
SERVO CHARACTERISTICS (FIG.13)			
JOINT VISCOSITY (FIG.18B)			
RIGHT	THIGH YAW	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
LEFT	THIGH YAW	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	



FIG.44

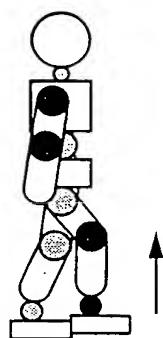
<u>STIFF JOINT CHARACTERISTICS</u>			
SERVO CHARACTERISTICS (FIG.12)	<u>TIME PERIOD WHEN A SOLE LEG IS IN STANCE (ANOTHER LEG BEING LIFTED)</u>		
JOINT VISCOSITY (FIG.18A)	<u>ROBOT BODY (LEGS, BODY TRUNK AND ARMS) FORMS AN OPEN LINK SYSTEM WITH FLOOR SURFACE</u>		
<u>INTERMEDIATE JOINT CHARACTERISTICS</u>			
SERVO CHARACTERISTICS (FIG.13)			
JOINT VISCOSITY (FIG.18A)			
<u>SOFT JOINT CHARACTERISTICS</u>			
SERVO CHARACTERISTICS (FIG.13)			
JOINT VISCOSITY (FIG.18B)			
			
RIGHT	THIGH YAW	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	THIGH ROLL	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
LEFT	THIGH YAW	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	THIGH ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.45

STIFF JOINT CHARACTERISTICS	SERVO CHARACTERISTICS (FIG.12)	TIME PERIOD WHEN A SOLE LEG IS IN STANCE	
	JOINT VISCOSITY (FIG.18A)	ROBOT BODY (LEGS, BODY TRUNK AND ARMS) FORMS AN OPEN LINK SYSTEM WITH FLOOR SURFACE	
INTERMEDIATE JOINT CHARACTERISTICS	SERVO CHARACTERISTICS (FIG.13)		
	JOINT VISCOSITY (FIG.18A)		
SOFT JOINT CHARACTERISTICS	SERVO CHARACTERISTICS (FIG.13)		
	JOINT VISCOSITY (FIG.18B)		
RIGHT	THIGH YAW	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	THIGH ROLL	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
LEFT	THIGH YAW	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	THIGH ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.46

<u>STIFF JOINT CHARACTERISTICS</u>	
SERVO CHARACTERISTICS (FIG.12)	
JOINT VISCOSITY (FIG.18A)	
<u>INTERMEDIATE JOINT CHARACTERISTICS</u>	
SERVO CHARACTERISTICS (FIG.13)	
JOINT VISCOSITY (FIG.18A)	
<u>SOFT JOINT CHARACTERISTICS</u>	
SERVO CHARACTERISTICS (FIG.13)	
JOINT VISCOSITY (FIG.18B)	

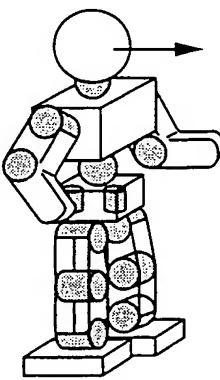
		TIME PERIOD WHEN BOTH LEGS ARE IN STANCE	
LOWER LIMBS FORM A CLOSED LINK SYSTEM WITH FLOOR SURFACE			
			
RIGHT	THIGH YAW	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
LEFT	THIGH YAW	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.47

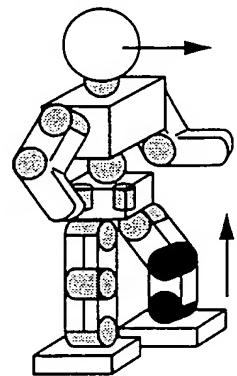
STIFF JOINT
 CHARACTERISTICS
 SERVO CHARACTERISTICS
 (FIG.12)
 JOINT VISCOSITY
 (FIG.18A)

INTERMEDIATE JOINT
 CHARACTERISTICS
 SERVO CHARACTERISTICS
 (FIG.13)
 JOINT VISCOSITY
 (FIG.18A)

SOFT JOINT
 CHARACTERISTICS
 SERVO CHARACTERISTICS
 (FIG.13)
 JOINT VISCOSITY
 (FIG.18B)

TIME PERIOD WHEN A SOLE
 LEG IS IN STANCE

ROBOT BODY (LEGS, BODY
 TRUNK AND ARMS) FORMS
 AN OPEN LINK SYSTEM
 WITH FLOOR SURFACE



RIGHT	THIGH YAW	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	THIGH ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
LEFT	THIGH YAW	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	THIGH ROLL	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.48

STIFF JOINT
CHARACTERISTICS
SERVO CHARACTERISTICS
(FIG.12)
JOINT VISCOSITY
(FIG.18A)

INTERMEDIATE JOINT
CHARACTERISTICS

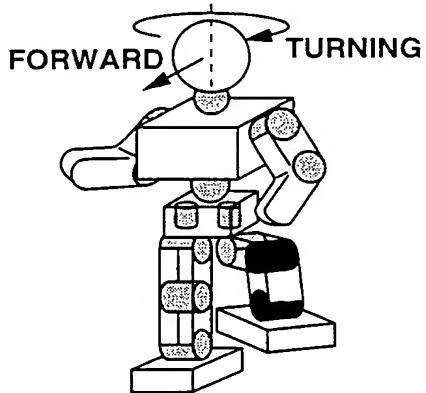
SERVO CHARACTERISTICS
(FIG.13)
JOINT VISCOSITY
(FIG.18A)

SOFT JOINT
CHARACTERISTICS

SERVO CHARACTERISTICS
(FIG.13)
JOINT VISCOSITY
(FIG.18B)

TIME PERIOD WHEN A SOLE
LEG IS IN STANCE

ROBOT BODY (LEGS, BODY
TRUNK AND ARMS) FORMS
AN OPEN LINK SYSTEM
WITH FLOOR SURFACE



RIGHT	THIGH YAW	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	THIGH ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
LEFT	THIGH YAW	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	THIGH ROLL	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

FIG.49

<u>STIFF JOINT CHARACTERISTICS</u>		TIME PERIOD WHEN A SOLE LEG IS IN STANCE	
SERVO CHARACTERISTICS (FIG.12)		ROBOT BODY (LEGS, BODY TRUNK AND ARMS) FORMS AN OPEN LINK SYSTEM WITH FLOOR SURFACE	
JOINT VISCOSITY (FIG.18A)			
<u>INTERMEDIATE JOINT CHARACTERISTICS</u>			
SERVO CHARACTERISTICS (FIG.13)			
JOINT VISCOSITY (FIG.18A)			
<u>SOFT JOINT CHARACTERISTICS</u>			
SERVO CHARACTERISTICS (FIG.13)			
JOINT VISCOSITY (FIG.18B)			
RIGHT	THIGH YAW	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	THIGH ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	STIFF JOINT CHARACTERISTICS
LEFT	THIGH YAW	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	THIGH ROLL	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN FLIGHT	STIFF JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN FLIGHT	SOFT JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

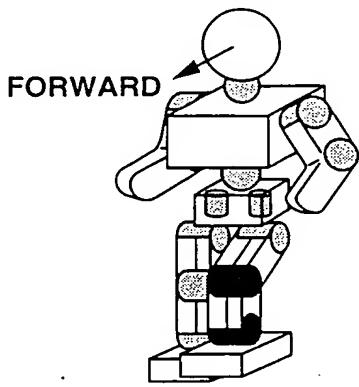


FIG.50

<u>STIFF JOINT CHARACTERISTICS</u>		TIME PERIOD WHEN BOTH LEGS ARE IN STANCE	
SERVO CHARACTERISTICS (FIG.12)		LOWER LIMBS FORM A CLOSED LINK SYSTEM WITH FLOOR SURFACE	
JOINT VISCOSITY (FIG.18A)			
<u>INTERMEDIATE JOINT CHARACTERISTICS</u>			
SERVO CHARACTERISTICS (FIG.13)			
JOINT VISCOSITY (FIG.18A)			
<u>SOFT JOINT CHARACTERISTICS</u>			
SERVO CHARACTERISTICS (FIG.13)			
JOINT VISCOSITY (FIG.18B)			
RIGHT	THIGH YAW	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
LEFT	THIGH YAW	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	THIGH PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	KNEE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE ROLL	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
	ANKLE PITCH	LEG IN STANCE	INTERMEDIATE JOINT CHARACTERISTICS
OTHER JOINT SITES		STIFF JOINT CHARACTERISTICS	

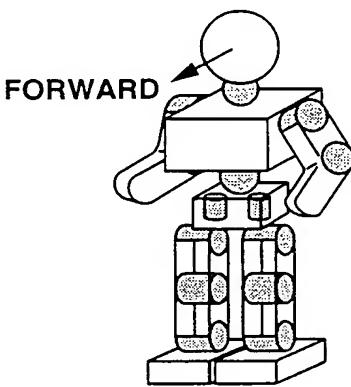


FIG.51

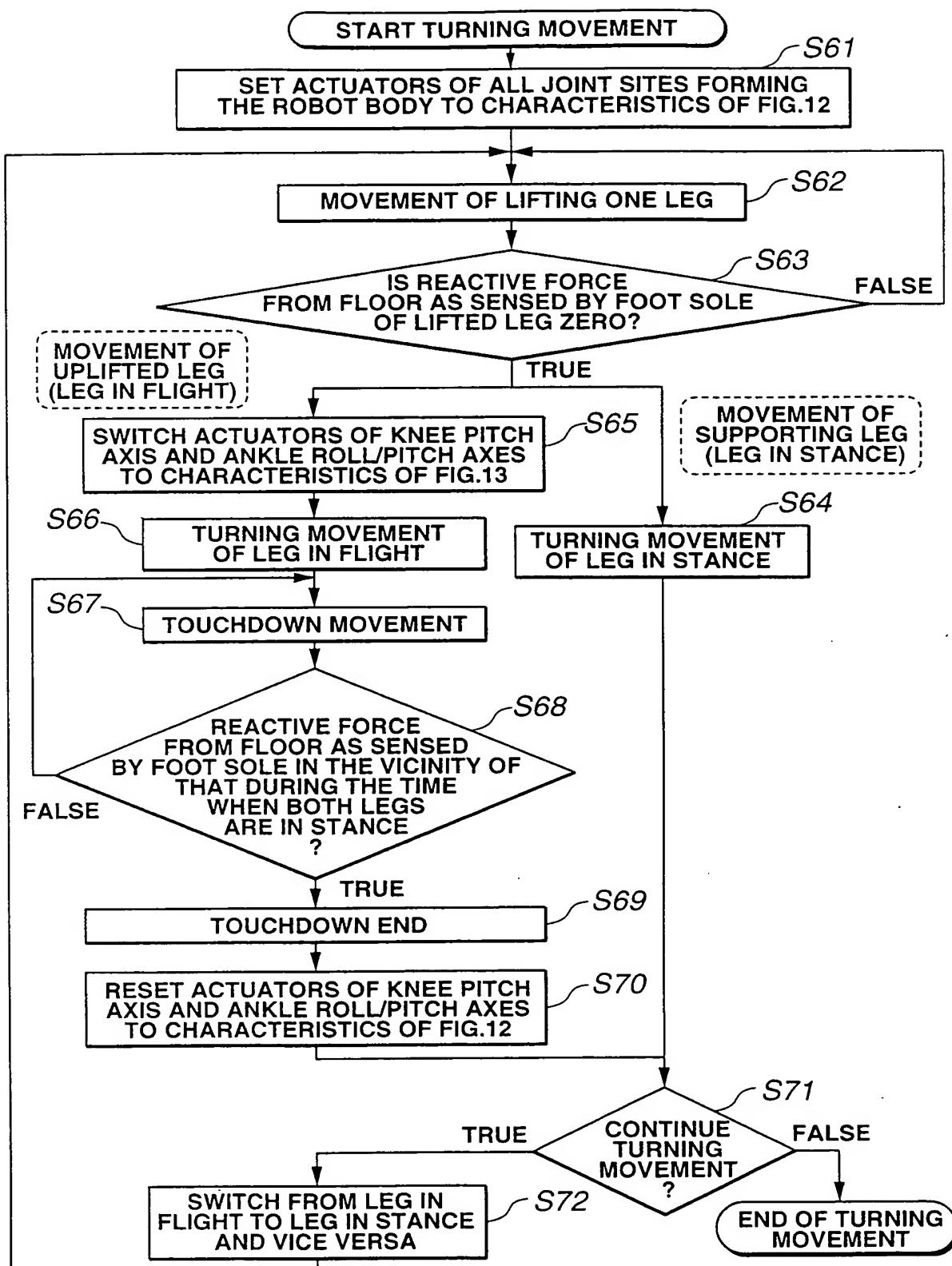


FIG.52